

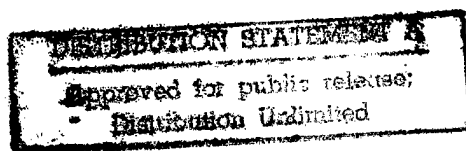
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11 December 1984

# USSR Report

ENERGY

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11 December 1984

# USSR REPORT

## ENERGY

### CONTENTS

#### FUEL

#### OIL AND GAS

Minister Names Recent, Future Earth-Sciences Techniques (Ye. A. Kozlovskiy; EKONOMICHESKAYA GAZETA, No 33, Aug 84)	1
Yamburg Gas Condensate Field Development Discussed (VYSHKA, 28 Aug 84)	6
Neftechala Oil Recovery Levels Meet Plan (G. Sakhavatov; VYSHKA, 18 Jul 84)	8
Forecasting Collector Properties of Deep Rock Tried (S. M. Kazakova; GEOLOGICHESKIY ZHURNAL, No 5, 1984)	9
Ways To Improve Oil, Gas Exploration in Turkmenistan Named (Ch. M. Paytykov; IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR: SERIYA FIZIKO-TEKHNICHESKIKH, KHIMICHESKIKH I GEOLOGICHESKIKH NAUK, No 3, 1984)	18
West Turkmenia Depression Possibly Petroliferous (V. F. Borzasekov, S. I. Guseva; IZVESTIYA AKADEMII NAUK TURKMENSKOY ASSR: SERIYA FIZIKO-TEKHNICHESKIKH, KHIMICHESKIKH I GEOLOGICHESKIKH NAUK, No 3, 1984)	23
Suggestions for Caspian Oil Output Increase Cited (A. Derepaskin, G. Larin; NARODNOYE KHOZYAYSTVO KAZAKHSTANA, No 7, Jul 84)	29
Oilfield Mechanic Shortages Discussed (D. Khodzha-Mukhammed; TURKMENSKAYA ISKRA, 14 Aug 84)	33
Establishment of Labor Safety Association Suggested (Yu. Ismaylov; VYSHKA, 10 Aug 84)	35

Orenburg Prepares for Karachaganak Gas (I. Payvin; SOTSIALISTICHESKAYA INDUSTRIYA, 1 Aug 84) ...	37
---	----

#### Briefs

Oilworker's History, Work Recounted	39
First Adygeyskaya Well Operating	39
Associations' Recovery Levels Cited	39
Boiler Furnaces Oil-Fueled	39
Astrakhan Development Well Operative	39
Compressor Station Startup Announced	40
Sangachala Drillers Beat Deadline	40
Maintenance Brigade Efforts Cited	40
Northern Balkun Refinery Operable	40
New Tubing for Tyumen	40
Tarsdallyar Field Begins Operation	40
Usinsk Recovers Millionth Ton	41
Above-Plan Recovery in Udmurtiya	41
Arlanneft' Know-How Pays Off	41
Yuzhkuzbassugol' Miners Exceeding Quotas	41
Transportable Dams Save Time	42
Kalamaddin Field Recovery Progressing	42
Caspian Slant-Hole Wells Producing	42
Computer Aids Petroleum Research	43

#### COAL

L'vov-Volyn Coal Basin Reserves Increased (M. A. Samarin, et al.; GEOLOGICHESKIY ZHURNAL, No 4, 1984)	44
New Approach to Underground Machinery Repair Proposed (RABOCHAYA GAZETA, 8 Sep 84) .....	50
Latest Developments in Plow Technology Reviewed (M. Lobasov; RABOCHAYA GAZETA, 24 Aug 84) .....	54
Fluidized Bed Technology Improves Donetsk Air Quality (A. Didur; SOTSIALISTICHESKAYA INDUSTRIYA, 13 Sep 84) ...	56
Briefs	
Nizhnevartovskneftegaz Oil Production Lags	58
Vakhrushevugol' Production, Productivity Up	58
Mine Production Exceeds Plan	58

#### ELECTRIC POWER

##### NON-NUCLEAR POWER

Kamaz Power Station Construction Behind Schedule (STROITEL'NAYA GAZETA, 4 Jul 84) .....	60
--	----

New Pumped Storage Plant Under Construction in Zagorsk (A. Perevoshchikov; SOVETSKAYA KIRGIZIYA, 3 Aug 84) .....	62
Azerbaijan To Get High Voltage Overhead Power Line (VYSHKA, 4 Jul 84) .....	64
Potential Reserves of Small Rivers for Energy Supply Discussed (D. Zhimerin, et al.; PRAVDA, 7 Jul 84) .....	65
Gas Line Construction to Ladyzhin GRES (N. Baras'; PRAVDA UKRAINY, 18 Jul 84) .....	68
Successful Installation of LEP-750 (A. Panchenko; SOTSIALISTICHESKAYA INDUSTRIYA, 29 Jul 84) .....	70
Construction Report on Zagorskaya GAES (A. Perevoshchikov; TIKHOOKEANSKAYA ZVEZDA, 8 Aug 84) ...	72

#### NON-NUCLEAR POWER

Zagorsk GAES Subcontractors Quarrel, Endanger Plant Core (A. Shabashkevich; LENINSKOYE ZNAMYA, 31 Jul 84) .....	74
Briefs	
Stavropolskaya GRES Shifts to Gas	77
Concreting Krapivinskaya GES Dam	77
Krivoporozhskaya GES Spillway Construction	77
Sayano-Shushenskaya GES Equipment Deliveries	78
Miscellaneous Power Developments	78
Permskaya GRES Gas Supply	78
Nizhnekamskaya GES Developments	79
Novosibirsk TETs-5 Construction	79
Power Line Construction	79
Power Substation	79
Novocherkassk GRES	79
Ladyzhin GRES	79
Tash-Kumyr GES	80
Novoangrenskaya GRES	80
Ekibastuz GRES	80
Power to Nakhichevan	80

#### PIPELINES

##### PIPELINE CONSTRUCTION

Deputy Minister Discusses Pipeline Construction (Grigoriy Nikolayevich Sudobin; SOTSIALISTICHESKAYA INDUSTRIYA, 2 Sep 84) .....	81
Progress in Building Oil, Gas Industry Facilities Reviewed (Editorial; STROITEL'STVO TRUBOPROVODOV, No 8, Aug 84) ..	84

Progress in Developing Outfitted Modules Analyzed (STROITEL'STVO TRUBOPROVODOV, No 8, Aug 84) .....	86
Technical Progress in Outfitted-Module Construction Analyzed (V. A. Alyutov; STROITEL'STVO TRUBOPROVODOV, No 8, Aug 84)	94
Ways for Improving Outfitted-Module Construction Muled (N. S. Morozov, A. B. Rubinshteyn; STROITEL'STVO TRUBOPROVODOV, No 8, Aug 84) .....	102
New Insulation, Protective Polymer Cited (V. Lagovskiy; SOTSIALISTICHESKAYA INDUSTRIYA, 19 Aug 84)	108
International Gas Pipeline Collectives Cited (A. Shkulev; KOMMUNIST, 8 Aug 84) .....	110
Gas Main Construction Progress Outlined (G. Veselkov; EKONOMICHESKAYA GAZETA, No 37, Sep 84) ....	112
Briefs	
Belorussian Gas Pipeline Completed	114
Tallin Delivers Arctic Excavators	114
Urengoy-Center-1 Pipeline Completed	114
Lakokraska Develops Pipeline Paint	115
Chuvash Pipeline Welding Automated	115
Yamalo-Nenets Underground Pipeline Begun	115
Pipeline Transports Gas-Oil Combination	115
Yamalo-Nenets Pipeline Construction Begins	116
Oxygen Rustproofs Pipelines	116
Udmurtiya Pipeliners Begin Construction	116

## OIL AND GAS

### MINISTER NAMES RECENT, FUTURE EARTH-SCIENCES TECHNIQUES

Moscow EKONOMICHESKAYA GAZETA in Russian No 33, Aug 84 p 2

[Article by Ye. A. Kozlovskiy, USSR Minister of Geology: "New Routes of the Underground Explorers"]

[Text] The 26th CPSU Congress gave our industry the task of providing for the further accelerated development of geological study of the country's land and of increasing the explored reserves. Specific goals for strengthening and expanding the minerals and raw-materials base were set by the USSR Energy and Foodstuffs Programs.

During the first 3 years of the five-year plan geological exploration increased 20 percent in volume, deep drilling 15 percent. Geological study of the country's land on medium scales is being completed. Large-scale geological surveys have covered about 30 percent of its area.

Altogether 385 fields of useful minerals whose reserves have been approved by the State Commission on Mineral Reserves under the USSR Council of Ministers were prepared in 1981-1983 for industrial assimilation.

The concentration of forces and material resources at the main areas and targets and completion of the exploration of a number of gigantic fields have enabled the five-year plan for growth in explored gas reserves to be met ahead of time.

Large deposits of coking and steam coal have been explored in the Donbass [Donets Coal Basin], the Kuzbass [Kuznetsk Coal Basin] and the Kansk-Achinsk, South Yakutsk and other basins, with total reserves of 11.4 billion tons, through which the construction of underground and open-cast mines with a total productivity of 156 million tons of coal year is being provided for. Exploration of fields of raw materials for producing mineral fertilizer is proceeding successfully in new regions: for phosphorites in Uzbekistan and Estonia, for apatites in Yakutia and the Ukraine, and for potash salts in Irkutsk Oblast.

Ferrous metallurgy's raw-materials base has been strengthened in the main iron-ore regions--in the Krivoy Rog basin, at the KMA [Kursk Magnetic Anomaly] and in the Northwest. In Kazakhstan, exploration at Almaz-Zhemchuzhina, the largest chromium ore field, has been completed and creation of the country's

third manganese-ore base is being completed. The raw-material potentials of the existing mining-and-beneficiating and mining-and-metallurgical enterprises of nonferrous metallurgy have been greatly expanded.

An outstanding scientific and technical achievement is the drilling of the Kola Superdeep Hole, which is first in the world to reach a depth of 12 km.

Unique data about the structure, composition and physical state of ancient formations in deep horizons of the earth's continental crust have been obtained. During preparation for and during the process of developing the Kola hole, the theoretical bases for superdeep drilling and basically new technical means for drilling to depths of 10-15 km were created. Penetration of the Saatly hole in Azerbaijan continues. In brief, there is reason for the geologists to be proud.

At the same time, various organizations and enterprises of the branch still have not provided for rhythmic, uninterrupted operation. The ministry has permitted a lag in carrying out plans for deep exploratory drilling for oil and gas and for a growth in oil reserves. There is a large reserve for improving the activity of geological organizations and for increasing prospecting and exploration effectiveness by eliminating the existing deficiencies.

The plan for geological exploration in 1984 is oriented to securing the positive trends that have been achieved and paving the way for carrying out the five-year plan. It is aimed at further dynamic development of the country's minerals and raw-materials potentials.

Geological exploration for oil and gas is being performed intensively in West and East Siberia, the Caspian depression, the Timan-Pechora province and East Turkestan. With a view to realizing the tasks of the Foodstuffs Program, a further increase in explored reserves for extracting raw materials for producing mineral fertilizer is being conducted, basically in new regions.

In connection with the approaching completion of construction of the Baykal-Amur Mainline and the forthcoming conquest of the natural resources of the area of its transport and economic influence, the preparation of explored reserves of useful minerals for the TPK [regional production complex] that is being formed and planned here has become especially acute. Exploration of the iron-ore fields of the Chara-Tokko and Yuzhno-Aldan regions in South Yakutia, which will become a raw materials base for a large metallurgical plant, and of the Kholodninskiy lead and zinc field in Buryatia, is being completed in 1984.

Growth in Amounts of Geological Exploration (1980 = 100 percent)	
1980.....	100
1981.....	107.0
1982.....	114.5
1983.....	120.4
1984 (planned)...	129.4

If the significance and complexity of the tasks being faced are considered, geological exploration in 1984 increased 7.5 percent in volume over 1983.

Almost 3.9 million meters of deep hole are to be drilled--8 percent more than in 1983, plus about 23 million meters of core-drilled hole, and 300,000 meters of underground mine workings are to be driven.



An increase in the production potential and improvement in the housing and personal-services situation for explorers of the earth depend directly upon an increase in the efficiency of capital construction. Its volume in 1984 will grow 1½-fold over 1983, and the plan for introducing apartment houses will increase 1.2-fold, facilities for production purposes 1.5-fold.

An analysis of the status of geological operations for the current year indicates that the tasks established and the commitments adopted are being carried out basically.

In accordance with the plan, the exploration of 44 fields of minerals whose reserves have been approved by USSR GKZ [State Commission for Mineral Reserves] has been completed and new storehouses of mineral raw materials have been discovered.

Realization of the 1984 plan is important not only in and of itself but it is also of decisive importance for fulfilling five-year plan tasks as a whole.

For most useful minerals, the five-year plan tasks were met ahead of time. At the same time, for a number of types of mineral raw materials an extremely tense situation has been created. This relates primarily to the fulfillment of plans for deep exploratory drilling and increase in oil reserves, in which a lag was permitted in past years, as has already been noted.

Of special importance is a rise in the efficiency of the oil and gas work by RSFSR Mingeo and its organizations--Glavtyumen'geologiya [Main Administration for Geology of Tyumen Oblast] and Yeniseyneftegazgeologiya [Administration for Oil and Gas Geology of the Yenisey Region], and also by Kazakh SSR Mingeo and its Guryevneftegazgeologiya and Aktyubinskgeologiya Associations. In 1984-1985 the exploration of large iron-ore fields in the Ukraine (Gulyaypole), the KMA region (the Lebedinskoye and Mikhaylovka), Kazakhstan (the Kachar and Zapadnyy Karazhal), the BAM zone (the Tarynakhskeye, Desovskoye and Tayezhnoye) and of manganese fields in Georgia (the Chiatura) and in the Ukraine (the B. Tekmak) must be completed. The lag in construction and installing work must be overcome as soon as possible.

The mineral and raw-materials base with which the national economy will enter the 21st Century should be created now, in the 1980's.

Accelerated promotion of work on geological study of the country should be accompanied by an improvement in the quality of geological mapping. Conversion to compilation of the USSR State Geological Map on a scale of 1:50,000 will lead to a rise in the authenticity and informativeness of geological documentation, based upon the wide use of the data of geophysical and geochemical research and aerial and space surveys in unison with traditional methods.

Conversion from studying the earth's deep structure by drilling solitary holes and laying out geophysical profiles in separate regions to the systematic study of the whole country's deep structure is under way. This calls for a system of mutually coordinated regional geophysical profiles that rely upon superdeep and deep holes.

Based upon an analysis of the results of regional geological and geophysical research and the use of the data of space-geological and aerial-geophysical

surveys, standard tectonosphere models for areas with different geodynamic environments will be defined, including the main petroliferous and ore-bearing regions for the country as a whole.

Taking the achievements of many branches of the geological sciences into account, further progress will be made in mineralogenesis--study of the principles that govern the forming and distribution of useful minerals--which will promote reliability in quantitative forecast evaluations of useful mineral reserves. The problem of prospecting for deep-lying fields that do not outcrop is becoming increasingly urgent. We see its solution in improvement of edaphic forecasting, and also in a rational combining of geological methods with geophysical, geochemical and high-altitude aerial methods and highly productive hole drilling.

The necessity for finding and utilizing in integrated fashion all the constituents of useful minerals requires deep study of the material composition of rocks and ores and further improvement of industrial research. Use of the achievements of solid-state physics, crystal chemistry and physical chemistry, and also of modern methods for studying matter--electron microscopy and X-ray diffraction, laser-optics and spectroscopic methods--have enabled the level of study of the substances of mine rock and ores to be sharply raised at all stages of geological exploration.

At the juncture of mineralogy and the technology for processing mineral raw materials, industrial mineralogy, which develops methods for intensifying the conquest of the earth's riches--their integrated utilization, increase in the recovery of all useful components (the creation of a wastefree technology) and the use of geotechnological methods for working fields--is being developed. The role of this scientific field is growing increasingly in connection with the development of lean ores and the application of new industrial processes.

The strategy for developing geological exploration is linked directly with the manner in which it is reequipped. One of the component problems is that of creating basically new geophysical equipment for prospecting for and exploring fields of useful minerals that is based upon the achievements of allied sciences (mathematics, physics, automation, remote control and instrumentmaking), particularly the development of apparatus for the direct prospecting of fields of useful minerals, including three-dimensional seismic exploration that uses the principles of holography. In order to study the deep structure of the earth's crust, the introduction of high-capacity excitation sources, such as MGD's [magnetohydrodynamic generators] and laser systems, and new principles for observing the parameters of physical fields, is important. For the purpose of improving the transmission of geophysical information, the newest telemetry systems, including the use of satellite communications, must be developed.

The geological branch is increasingly obtaining information it needs from piloted orbital stations and artificial earth satellites. Integrated research performed by cosmonauts is making a considerable contribution to study of the earth's interior and is helping to find fields of useful minerals. In particular, we have obtained much valuable information also from international space crews.

The collaboration of the geologists of CEMA member countries is bearing meaningful fruit. Integrated programs of geological work that are performed within the framework of socialist economic integration will enable the mineral raw-materials bases of all participants in the collaboration to be developed harmoniously and advanced methods and progressive technical means for geological exploration to be introduced more rapidly.

11409

CSO: 1822/28

## OIL AND GAS

### YAMBURG GAS CONDENSATE FIELD DEVELOPMENT DISCUSSED

Baku VYSHKA in Russian 28 Aug 84 p 2

[Article: "Official Department. To Yamburg, the Underground Storehouse"]

[Text] As has already been reported in print, the Politburo of the CPSU Central Committee has been looking at the question of insuring that the Yamburg gas condensate field in the Tyumen oblast is put into operation.

In the resolution adopted by the CPSU Central Committee and the USSR Council of Ministers on this question emphasis is placed on the fact that thanks to the creative efforts and selfless labor of the geologists, gas industry workers and construction workers, to the great organizational and political work conducted by the party, soviet, industry, trade union and Komsomol organizations, high growth rates are being insured in the country's gas industry, and as a result of the discovery of the unique gas and gas-condensate field in Western Siberia, a raw material base for the future speed-up this industry's growth has been established.

Considering that the Yamburg gas-condensate field will have to be the principal raw material base insuring the increase in gas recovery levels during the forthcoming five-year plan, the CPSU Central Committee and the USSR Council of Ministers have acknowledged that the most important national economic task of the 12th Five-Year Plan is to increase gas recovery levels and to keep up the gas industry's high growth rate which has already been achieved in Western Siberia by putting this field into operation.

Specific tasks to insure utilization, during the development and putting into operation of the field, of the newest achievements of science and technology and highly efficient equipment, broad incorporation of automation and mechanization of production processes, high-quality preparation of gas and gas-condensate at the recovery site for future transport and environmental protection measures have been assigned to USSR ministries and departments.

Thus, Mingazprom [Ministry of the Gas Industry] and Minneftegazstroy [Ministry of Construction of Petroleum and Gas Industry Enterprises] have been assigned tasks pertinent to the establishment of production capacities for gas and gas-condensate recovery; Minkhimmash [Ministry of Chemical and Petroleum Machine Building], Minpribor [Ministry of Instrument Making, Automation Equipment, and Control Systems], Minenergomash [Ministry of Power Machine Building], Min-

elektrotekhprom [Ministry of the Electrical Equipment Industry] and Minchermet [Ministry of Ferrous Metallurgy] are to produce new types of equipment and tubing of Arctic design for well drilling and field development in permafrost conditions; and USSR Minenergo [Ministry of Power and Electrification] and Mintransstroy [Ministry of Transport Construction] are to build and put transmission lines, electric substations, paved roads and a rail line from Urengoy to Yamburg into operation.

Ahead-of-schedule development of a transportation network, power supply facilities and housing construction are foreseen during construction of the Yamburg gas-condensate field.

The USSR Academy of Sciences, Mingazprom and Ninnftegazstroy have been assigned the task of carrying out a series of scientific and research operations in the Yamburg gas-condensate field to comprehensively study the permafrost and to draw up recommendations for the development of an industrial and social infrastructure in this region.

12659  
CSO:1822/446

## OIL AND GAS

### NEFTECHALA OIL RECOVERY LEVELS MEET PLAN

Baku VYSHKA in Russian 18 Jul 84 p 1

[Article by G. Sakhavatov, "In a Persistent Quest"]

[Excerpts] Neftechala--For the first time in the last 3 years, Neftechalaneft', an NGDU [Oil- and Gas-Extracting Administration] collective, has overcome its lag and has brought oil recovery up to the level of the plan. The petroleum delivery quota for the first half-year has been met by 100 percent.

During the last three years 120 wells have been brought out of shut-down status and more than half of them have been put into operation ahead of schedule.

"That's not the limit of what we can do", says a driller. Having considered their resources and potentialities, the brigade has decided to overhaul 25 more wells before the end of this year and thereby create conditions favorable to the successful fulfillment of the plan and obligations for oil and gas recovery.

The conversation about repair work is not just casual talk. Until recently there was a labor turnover, absenteeism and tardiness here. Many oil wells stood idle for long periods of time because of low labor and production discipline. It was impossible to tolerate such a situation. So the management and the shop's party and labor union organizations undertook an all-out struggle to strengthen the extent of organization and order, using for this a form of influence on people which acted as a personal example of a communist and a mentor.

The Arlan method of evaluation and wages for repair workers can also be used to advantage in old areas where water encroachment and frequent sand bridges have a negative effect on well operation.

"Yes, the quality of well repair is the chief indicator", says Balabek Guliyev, chief engineer of the Neftechalaneft' NGDU. And, too, well shutdowns for repair are used in the fields to conduct geological and technical measures in the wells. Since the beginning of the year, about 300 of them have been performed, and as a result over 11 thousand additional tons of oil have been recovered. Growth is guaranteed, thanks to the engineering search for reserves. At the end of June we had succeeded in raising the daily recovery level of oil by 30 tons.

FORECASTING COLLECTOR PROPERTIES OF DEEP ROCK TRIED

Kiev GEOLOGICHESKIY ZHURNAL in Russian No 5, 1984 (signed to press 6 Sep 84)  
pp 121-127

[Article by S. M. Kazakova (VNIIneft' [All-Union Scientific-Research Institute for Oil and Gas], Moscow): "Forecasting the Collector Properties of Petroliferous Rocks at Great Depths (in the Example of Upper Carboniferous and Visayan Sandstones of the Dnepr-Donets Depression)"]

[Text] The information we are presenting is a survey of the collector properties of Carboniferous sandstones at depths of more than 4,000 meters, by way of making an overall statement of the problem [4, 5, 1 and 11]. More than 200 holes with a bottom-hole depth greater than 4,000 meters have been drilled in the Dnepr-Donets depression (DDV). We have used the data on 33 holes in constructing graphs that describe the collectors' porosity and permeability changes. The Carboniferous sediments have been described in greater detail previously [2, 6-8, 4 and 5 and others], so we limit ourself to a brief description of them.

The Lower Carboniferous sediments are marked by great diversity of the rocks. The Tournasian stage is characterized by the development primarily of carbonate and, more rarely, terrigenous (in the DDV's northeast) formations. In the DDV the Visayan stage is subdivided into Lower Visayan and Upper Visayan sediments. The first are primarily carbonates with sandstone interbeds, the second are terrigenous. The oil and gas confined to Visayan sediments lie at great depths. The Namurian stage in the DDV is marked by a predominance of clayey rocks, which form a cap for the oil and gas deposits in the Visayan sediments, and only sometimes oil and gas deposits are confined to Namurian collectors.

The Middle Carboniferous sediments in the DDV are represented by the Bashkirian and Moscovian stages. The Bashkirian stage is complicated by Lower Bashkirian argillites, limestones with sandstone interbeds, and Upper Bashkirian sandstones with aleurolite interbeds. Lower Bashkirian sediments are characterized by relatively weak permeability and, together with the Namurian, they form regional caps. The Upper Bashkirian sediments are rich in oil and gas collectors. The Moscovian stage contains good collectors--sandstones interbedded with argillites.

The Upper Carboniferous sediments are distinguished by substantial development of good oil and gas collectors, which are thick sandstones. However, cap rocks are almost nonexistent in the Upper Carboniferous. In those cases where these caps do exist, oil and gas fields are formed in the Upper Carboniferous.

All the stratigraphic subdivisions of the normal DDV profile submerge gradually in the southeast direction--toward the Donbass. Therefore, the shallow rocks which are accessible for study in the northwestern part of the DDV turn out to be deeply submerged toward the southeast. The greatest depths of burial of the crystalline basement are: beside Srebnoye village--7 km, near the city of Poltava--9 km, and close to the Donbass [Donets Coal Basin] (the Lozovaya Railroad Yard)--14 km.

In the deep zones of the DDV's Paleozoic-sediment profile are granular, carbonate and fractured collectors. The granular collectors are terrigenous rocks--from large-grained sandstones to fine aleurolites. Sandstones of medium size and small grain are most widely distributed. An examination of the consistency of change of the sandstones' collector properties as a function of the sandstones' depth of bedding should begin with the younger sediments. They fill up the central graben and those that are more distant from the side fractures, a fact that strongly distorts the picture of consistent change in the porosity and permeability of the rocks as their deposition depths increase. Therefore, we shall successively examine changes in the characteristics of the sandstones of the Upper Carboniferous and Viseyan sediments. Each age of the rock group is characterized by a corresponding graph in which the ordinate axis represents changes in depth of deposition of the collectors and the abscissa represents changes in porosity and permeability of the rocks (figures 1-4). Each analysis is represented on these charts by a corresponding point. Plotting the series of points according to the analytical data can show the behavior of the sandstone collectors for the various holes and areas, by age group as a whole.

The Upper Carboniferous Sandstones. Upper Carboniferous sediments are found at depths of more than 4,000 meters at a number of structures within the Poltava cross-depression. We trace the change in the characteristics of Upper Carboniferous sandstones with increase in the bedding depth in accordance with data for the Lannovskaya and Mashevskaya areas, which are in the relatively static tectonic state that is typical of the middle of the Poltava cross-depression and maximum thickness of the Paleozoic. In figure 1, in drawing the dotted lines through the series of points of  $\Pi$ , we get two boundary lines--Ia and I $\delta$ . They indicate changes in the maximum (curve Ia) and the minimum (curve I $\delta$ ) porosity of the sandstones. All the remaining points are located between the boundary lines. The only exception may be the rare samples with anomalously high (the so-called "hurricane") values of sandstone porosity which are caused by loss of cementation of the sandstones along fractures near tectonic fractures. Such "hurricane" anomalies are not encountered within the Lannovskaya and Mashevskaya structures.

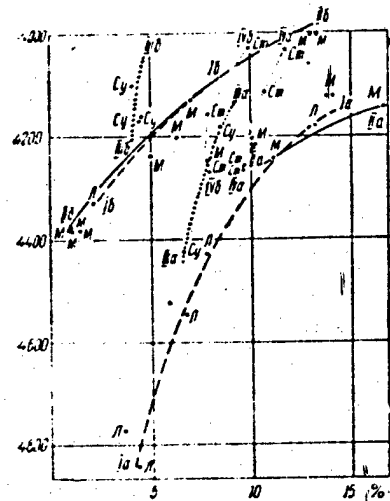
The maximum porosity of the Upper Carbonaceous sandstones at the Lannovskaya structure is systematically reduced from 13 percent at a depth of 4,230 meters to 3 percent at 4,800 meters. This gives a reduction in maximum porosity of 10 percent at a depth interval of 570 meters, that is, the gradient



Figure 1. Change of Porosity with Depth of Upper Carboniferous Sediments of the Dnepr-Donets Depression.

The boundary lines of porosity measurements for the structures: the Lannovskaya ( $\Pi$ )--Ia-Ia for the maximum and I $\delta$ -I $\delta$  for the minimum; the Mashevskaya (M)--IIa-IIa and II $\delta$ -II $\delta$ , respectively; the Sukhodolovskaya (Cy)--IIIa-IIIa and III $\delta$ -III $\delta$ ; and the Staroverovskaya (C $\tau$ )--IVa-IVa and IV $\delta$ -IV $\delta$ .

of reduction of maximum porosity is 1.7 percent per 100 meters of depth. The minimum porosity of Upper Carbonaceous sandstones at the Lannovskaya structure is reduced from 8 percent at a depth of 4,080 meters to 2 percent at 4,340 meters, that is, the gradient of reduction of minimal porosity is 2.3 percent per 100 meters of depth.



In comparing the values of the gradients for reduction in porosity of the Upper Carboniferous sandstones of the Lannovskaya structure, we come to the conclusion that they can be considered almost identical for its maximum and minimum values. The average value is 2 percent per 100 meters of depth. It is this that explains the parallelism of the lines Ia and I $\delta$  in figure 1.

In examining the changes in permeability (see figure 2), relationships that are basically convergent can be noted. Thus, on uniting the extreme points of  $\Pi$  in figure 2 and getting two boundary lines, we can determine accordingly the amounts of reduction in permeability of the Lannovskaya structure's Upper Carboniferous sandstones. Their maximum permeability changes from 8 md [millidarcies] at a depth of 4,180 meters to 0.1 md at 4,800 meters. This gives 7.9 md at 620 meters, or 1.3 md at 100 meters' depth. The minimum permeability of these same sandstones varies within very small ranges (fractions of a millidarcy).

Moving over to the characteristics of Upper Carboniferous sandstones of the Mashevskaya structures at depths of more than 4 km, we develop the boundary lines IIa and II $\delta$ . The maximum porosity values of the sandstones at the Mashevskaya structure (see figure 1) change from 16.5 percent at a depth of 4,120 meters to 11 percent at 4,240 meters. This gives 5.5 percent for 120 meters, or 4.6 percent for each 100 meters of depth. The minimum porosity of the Mashevskaya structure's Upper Carboniferous sandstones is reduced from 13 percent at a depth of 4,020 meters to 1 percent at 4,380 meters. This gives 12 percent at 360 meters' depth, or 3.3 for each 100 meters of depth. Consequently, porosity is reduced more rapidly with depth than at the Lannovskaya.

In comparing the point fields for the Lannovskaya and Mashevskaya structures, it can be noted that these fields are similar, but their boundary lines are inclined at different angles to the abscissa axis, which also indicates a different speed in reducing sandstone porosity at the different structures. The same thing also applies to the boundary lines of the point fields for the

Figure 2. Change of Permeability with Depth of Sandstones of Upper Carboniferous Sediments of the Dnepr-Donets Depression.

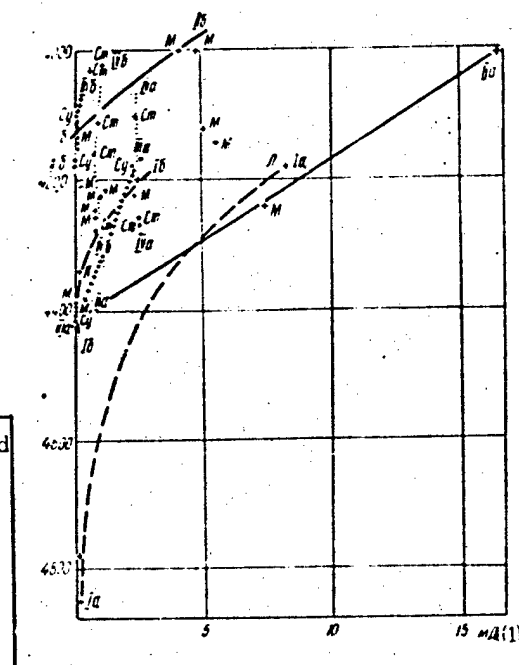
The boundary lines of change in permeability for the structures: the Lannovskaya (Л)--maximum Ia-Ia and minimum IБ-IБ; the Mashevskaya (М), respectively, IIa-IIa and IIБ-IIБ; the Sukhodolovskaya (Сy) IIIa-IIIa and IIIБ-IIIБ; and the Staroverovskaya (Ст) IVa-IVa and IVБ-IVБ.

Key:

1. Millidarcies.

Sukhodolovskaya (curves IIIa and IIIБ) and Staroverovskaya (curves IVa and IVБ) structures.

And so the Upper Carbonaceous sandstones in the DDV's central portion are characterized by systematic reduction in their porosity and permeability with depth. These changes occur differently for each structure, but, in general, they are similar. A more intense reduction for minimal porosity than the maximum is noted.

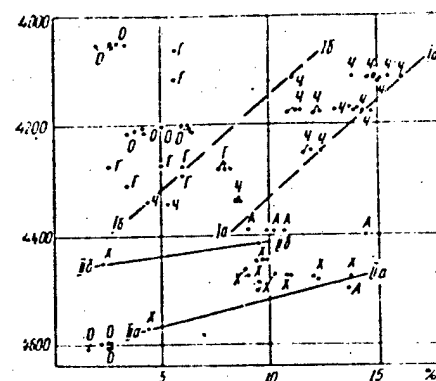


Lower Carboniferous (Visayan) Sandstones. Visayan sediments at depths of more than 4,000 meters have been found in the DDV in areas that are located within the Lyutenkovskiy cross-uplift and the Romenskaya cross-depression. It is desirable to describe the Visayan sandstones in the example of the Chizhevskaya structure, which is located in the northwest termination of the Glinsko-Rozbyshevskiy swell (see figure 3) and has promise for bearing oil and gas [11].

In plotting the data of the analyses (see figure 3) on the graph, one can outline on it a certain field with two boundary lines--Ia (maximum porosity) and IБ (minimum). The maximum porosity of the Visayan sandstones changes here from

Figure 3. Change in Porosity with Depth of Lower Carboniferous (Visayan  $C_1^V$ ) Sandstone Sediments of the Dnepr-Donets Depression.

Boundary lines of change of porosity for the structures: Chizhevskaya (Ч)--the maximum Ia-Ia and the minimum IБ-IБ; the Khar'kovtsevska (Х)--respectively IIa-IIa and IIБ-IIБ; and О the Oposhnyanskaya structure, А the Anastas'yevskaya, and Г the Gnedintsevska.



16.5 percent at a depth of 4,100 meters to 8.5 percent at 4,340 meters. This gives a porosity reduction of 8 percent for 240 meters of depth, or 3.3 percent per 100 meters. The minimum porosity of the sandstones changes from 11 percent at a depth of 4,100 meters to 4 percent at 4,340 meters, that is, the porosity reduction is 7 percent for 240 meters of depth, or 2.9 percent for every 100 meters.

The porosity characteristics obtained for the Visayan-age sandstones are similar to the corresponding characteristics of the Mashevskaya structure's Upper Carboniferous sandstones. However, the nature of distribution of the points on the graph for the Chizhevskaya structure are completely different from those for the Mashevskaya and Lannovskaya structures. It is evident on the graph of porosity of the Chizhevskaya structure Visayan sandstones (see figure 3) that the points are located on it in almost horizontal rows. This means that the porosity of the sandstones for the neighboring specimens change sharply at about the very same depth; for example, from 14.5 to 11 percent at depths of 4,170-4,8180 meters and from 9 to 4 percent at depths of 4,320-4,340 meters (see figure 3). All this indicates the phenomena of a loss of cementation of the sandstones in areas where the rocks were crushed during tectonic movements, which were confined to the axial zone of the Glinsko-Rozbyshevskiy swell, at the northwestern continuation of which is the Chizhevskoye oil and gas field. What has been said is also confirmed by a graph of the permeability of Chizhevskaya structure Visayan sandstones (see figure 4). As we see, sandstone permeability here at depths of 4,170-4,180 meters reaches anomalous--"hurricane"--values (up to 117 millidarcies). At depths of 4,320-4,340 meters, permeability fluctuates sharply--from 3 to 0.2 millidarcies. All this indicates that porosity, and even more so permeability, of the Chizhevskaya structure sandstones are caused mainly by the tectonic rather than the sedimentation factor.

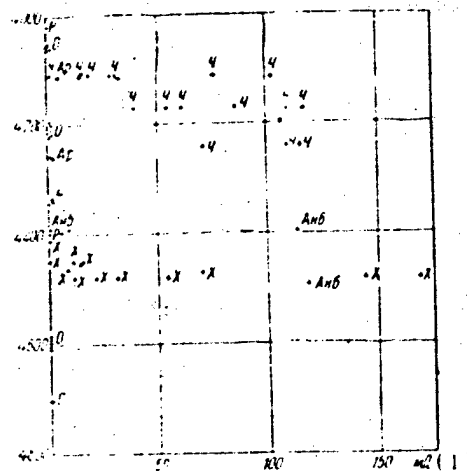
Figure 4. Change of Permeability with Depth of Lower Carboniferous (Visayan, C<sub>1</sub>) Sandstones of the Dnepr-Donets Depression.

The structures are: Ap--Artyukhovskaya; AH--Anastas'yevskaya; O--Oposhnyanskaya; P--Rudenskoyevskaya; C--Solokhovskaya; X--Khar'kovtsevska; and 4--Chizhevskaya.

Key:

1. Millidarcies.

Everything that has been said above is true also for the Khar'kovtsevska structure sandstones, which are located at the southeastern termination of the Glinsko-Rozbyshevskiy swell, as if it were symmetrical with the Chizhevskaya. However, at the southeastern termination of the Glinsko-Rozbyshevskiy swell, the influence of the tectonic factor on porosity and



permeability tells more strongly on the Visayan sandstones than on the Chizhevskaya structure. The porosity (maximum) for Visayan sandstones of the Khar'kovtsevsкая structure changes from 14 percent at a depth of 4,480 meters to 4 percent at 4,580 meters. In other words, a reduction in maximum porosity of 10 percent per 100 meters of depth is observed. The minimum porosity of these same sandstones changes from 9 percent at a depth of 4,410 meters to 2 percent at 4,450 meters. This gives a reduction in minimum porosity by 7 percent for 40 meters of depth, or 17.5 percent per 100 meters. A rapid reduction has been established here that is almost double the reduction in maximum porosity. All these peculiarities point to the fact that the depth interval analyzed at the Khar'kovtsevsкая structure is one of the deep zones of loss of seal of the rocks. The loss of seal apparently occurred as a result of loss of cementation when sandstones were washed by the ground water that circulates through the fractures and bedding planes.

Similar arguments may be cited also relative to the Visayan sandstones of the Oposhnyanskaya, Gnedintsevsкая and Anastas'yevskaya structures. It may also be noted that these structures, which are situated either in the side portion of the DDV (the Anastas'yevskaya) or at the cross-uplifts (Oposhnyanskaya and Solokhovskaya--at the Lyutenkovskiy cross-uplift), are sharply distinguished by the pronounced fracture type of porosity and permeability. The points on the graph are located in almost horizontal rows (see figures 3 and 4).

And so the collector properties of the petroliferous rocks change greatly with increase in the depth of their bedding. This results from the catagenesis of the sedimentary rocks with change of their porosity, filtering capabilities, and yield of oil and gas. In examining the porosity of the DDV's Carboniferous sandstones and their development in the catagenetic area, different types of porosity can be singled out: sedimentational (primary) and tectonic (secondary).

The Sedimentational Type is marked by a uniform reduction in porosity and permeability of the sandstones with their bedding depth. Maximal and minimal porosity are reduced in approximately equal measure, but a tendency toward a rapid reduction in minimal porosity is noted. These properties of change in porosity can be explained by the processes of sandstone cementation in deep areas and by the consistent change in the nature of their recementation with depth.

The Tectonic Type is characterized by relatively sharp and large fluctuations in the porosity and permeability of sandstones at nearby depths. Sometimes anomalously high--"hurricane"--values of porosity and permeability are encountered. These properties are explained by tectonic fracturing of the rocks and loss of cementation of the sandstones caused by it. This type of porosity and permeability is characteristic for relatively disturbed tectonic conditions.

In the structures' fracture zones secondary tectonic porosity developed in the form of rudimentary microcracks. In these zones the sandstones lose cement and their secondary porosity grows. Relative homogeneity of the substrate is noted in dense carbonate rocks. Tectonic porosity develops in them along with microdisplacements and along the lines of rock flow. These are

series of S-shaped microcracks disposed in echelon fashion. With change in the direction of the deforming tectonic forces, there is a restructuring of the microtectonic shove and a reforming of the pores into angular and triangular pores and then into multiple-pronged pores. The latter flow together and form microcracks. The development of microtectonic porosity in the sandstones is complicated by differences in the composition of the plastic particles and the cement. Since the material of the particles usually is more simple than the material of the cement, then, under strong directed pressure, there are a reorienting of the particles in the sandstones (especially those of nonuniform granularity) and destruction of the cement in their vicinity. This weakens the ties of the particles with the cement and facilitates the forming of microcracks in the rocks.

The tectonic fracturing that develops from tectonic porosity changes strongly the collector properties of petroliferous rocks, causing anomalously high values of porosity, permeability and yield of oil and gas. Where the particles have slight strength, the cement is stronger, and there is a strong directed pressure, destruction of the particles without breaking their ties with the cement can occur, but this happens rarely.

The rocks' geological age does not play a decisive role in determining their collector properties. The depth of the collectors' bedding and the hydrogeological and geothermal conditions are of decisive importance for sedimentational (primary) porosity. The tectonic setting of the structure and the history of its development, especially the last stages, are extremely important for tectonic porosity and fracturing.

The gradients of reduction in porosity of the sandstones that we have obtained exceed severalfold the values of the gradients computed in accordance with various mathematical formulas [3 and 9]. G. I. Etuoter and I. I. Miller (1980) studied 17,367 core samples (basically Miocene and younger sandstones) taken from holes at 101 fields and from many prospecting holes in the southern part of the state of Louisiana (USA). They established that on the average the deterioration of porosity is marked by a gradient of 4.15 percent per 1 km. J. K. Maxwell generalized data selected from various sources: he also analyzed more than 8,000 samples from formations, from the Ordovician to the Miocene (basically Tertiary) and observed that the gradients of deterioration of porosity are higher at those sections where the geothermal gradients are highest. The porosity gradients varied from 3.28 percent per 1 km for Oligocene sands at a geothermal gradient of 23 degrees C per 1 km to 8.4 percent per 1 km for sands of similar age at a geothermal gradient of 32.8 degrees C per 1 km [10].

The gradients we obtained exceeded severalfold the values of the gradients pointed out by these authors, for various reasons. First, the computed theoretical data had been averaged and did not consider the fluctuations of the specific environments of the various fields at various depth intervals. But these conditions are characterized primarily by definite tectonic conditions of the rock (microfracturing thereof and the loss of cementation of the sandstones caused by it). Second, the gradient values we obtained characterized definite structures and only specific depth intervals. A small number (compared with those presented by the above-indicated authors) of laboratory determinations of porosity and permeability make each of these

determinations random to a certain extent. However, it must always be remembered that randomness is a phenomenon of definite consistency. Therefore, the higher gradients of porosity reduction that we obtained require further study, even if they also do not concur with today's theoretical principles.

The changes in porosity and permeability of sediments with depth that we have found for specific oilfield areas of the DDV can be used successfully when prospecting for and exploring new oil and gas fields and when computing their reserves, and also in potentially petroliferous regions, especially in regions already known ("old" regions), taking into account their lithofacies and the tectonic conditions--in Ciscaucasia, for example.

#### Summary

Carboniferous sandstones of the Dniepr-Donets depression (DDD) are considered for their porosity and permeability at the depths above 4 km. Sedimentation (primary) and tectonic (secondary) types of porosity are distinguished. The porosity and permeability variations with the depth of occurrence found for the concrete DDD oil fields may be used in prospecting new oil and gas fields in the other regions. [As printed in English.]

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## OIL AND GAS

### WAYS TO IMPROVE OIL, GAS EXPLORATION IN TURKMENISTAN NAMED

Ashkhabad IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR: SERIYA FIZIKO-TEKHNIЧЕСКИХ, ХИМИЧЕСКИХ И ГЕОЛОГИЧЕСКИХ НАУК in Russian No 3, 1984 (signed to press 10 Aug 84) pp 72-76

[Article by Ch. M. Paytykov (TurkmenNIGRI [Turkmen Scientific-Research Institute for Geological Exploration]): "The Problem of Increasing the Effectiveness of Prospecting and Exploration for Oil and Gas in Turkmenistan"]

[Text] A broad set of operations for geological exploration for oil and gas has been performed in recent years in the Turkmen SSR. This is explained, on the one hand, by the potential of this land in terms of hydrocarbon raw materials, and, on the other, by the vigorous development of the gas industry. Suffice it to say that Turkmenistan has reached second place in the country in gas recovery.

During the 10th Five-Year Plan a large amount of prospecting for oil and gas fields was done on the republic's promising lands. Sixty-three promising structures were prepared for deep drilling, about 1.2 million meters of deep drilling were completed, and 48 local folds were put to the drill. Vast geological information was obtained that allowed the land's promise in terms of oil and gas to be assessed with greater reliability, prospecting and exploration to be conducted with greater validity and purposefulness, and a number of fields and deposits to be discovered (table 1). An indubitable success of prospecting and exploration in these years was discovery of the Uchadzhi gas-bearing area, which is of principal importance. As is known, the prospects of the Neocomian sediments of the Murgab depression's vast lands, which are located east of the Murgab fault, were for many years a topic of spirited discussion. The consequence of this was that this vast territory, which had a substantial inventory of prepared structures, was not covered by deep drilling. The discovery in 1978 of the Uchadzhi gas field confirmed the correctness of the researchers who had assessed highly the prospects of "the Shatlyk horizon" also in this part of the Murgab depression. Six structures here were put to deep drilling, from which commercial gas flows were obtained at five (Uchadzhi, Vostochnyy Uchadzhi, Seyrab, Beshkizil and Yashlar).

An important result of the geological exploration was the appearance of commercial flows of hydrocarbons from subsalt sediments of the Murgab depression (Yashlar and Sandykachi). The prospects for these sediments has been assessed highly by all researchers, and practice confirms this assessment. Since the



Table 1

## Fields Discovered in Turkmenistan During 1976-1980

Field	Type	Year of discovery		Type	Year of discovery
Mollaker.....	Gas condensate	1976	Gagarinskoye.....	Gas	1978
Kapa-Tepe.....	Gas	1977	Vostochnyy Cheleken	Oil and gas	1978
Vostochnyy Tedzhen	Gas	1976	Yashlar.....	Gas and oil	1979
Keymir.....	Gas	1977	Sandykachi.....	Gas	1979
Ekiz-Ak.....	Gas	1977	Vostochnyy Uchadzhi	Gas	1979
Shorkel'.....	Gas	1978	Karadzhaulak.....	Gas	1979
Malay.....	Gas	1978	Beshkizil.....	Gas	1980
Uchadzhi.....	Gas	1978	Yuzhnoye Bugdayli..	Gas	1980
Seyrab.....	Gas	1978			

subsalt carbonate sediments of the Murgab depression will, during the 11th Five-Year Plan and over the long term, be one of the main targets of prospecting and exploration, the results obtained are difficult to overestimate. It should also be noted that at the Yashlar area, flows of light crude, along with gas, also were obtained. This means that the subsalt complex may be not only gas-bearing but also oil-bearing, and such a result, given the prevailing situation in the republic's oil-recovery industry, would be extremely important. The first results of deep drilling in the Beshkent trough indicate that its lands can now, during the 11th Five-Year Plan, become a new oil and gas bearing zone of the republic. During the 10th Five-Year Plan, the gas-bearing area of the Daulatabad-Donmez field was greatly expanded.

Commercial flows of gas obtained from Neocomian sediments in the Amu-Darya depression (the Malay area) compel reevaluation of the prospects of the more northerly Repetek-Cheshmin deep fault.

As before, the main amounts of work on oil in the region were performed in the republic's west (the Apsheronian-Balkhan and West Turkmen petroliferous areas) and were concentrated along three main directions: the upper red beds--the Akchagyl and Apsheronian sediments of the Balkhan uplift zone; the lower red bed sediments of the Balkhan zone; and Pliocene sediments of the Gograndag-Okarem uplift zone.

The worsening of effectiveness in prospecting and exploring for oil in the republic is explained by many factors, chief of which are: the high degree to which the main petroliferous complex--the upper red beds of the Balkhan region--had been explored; the greater depths of deposition of the lower red bed sediments, and their collector properties, which are poorer than those of the upper red beds; and the presence primarily of gas in the Pliocene sediments of the Gograndag-Okarem region; the sharp reduction in prospecting and exploration drilling volume that resulted from nonfulfillment of the planned amounts of work (1,188,000 meters were drilled through during the Eighth Five-Year Plan, 690,000 during the Ninth and 500,000 during the 10th). There are still a number of deficiencies that adversely affect prospecting and exploration effectiveness--primarily nonfulfillment of the drilling plan (83.3

percent). During the 10th Five-Year Plan 238,000 meters of penetration were not performed. The amount of drilling performed remains low. An increase in geological-exploration effectiveness depends upon the following factors.

1. An increase in productive time during drilling and a reduction of idle time. The main causes of idle time are the poor and delayed furnishing of supplies and equipment, the same faults in organizing drilling work, and personnel turnover. Eliminating these deficiencies will increase productive time during drilling.

2. Accidents greatly reduce drilling productivity and effectiveness. Despite a reduction in their number, total time losses during the 10th Five-Year Plan rose to 651 rig-months. It is obvious that a reduction in the accident rate is an important reserve for increasing labor productivity. Moreover, eliminating accidents requires substantial material and financial expenditures, which, in the final analysis, will increase drilling costs.

Studies have indicated that most accidents occur through the fault of the operators. Thus, out of 28 accidents that occurred in 1977-1978 in East Turkmen areas, 26 were the fault of the drilling brigades. Losses from these accidents alone were 467,000 rubles, and losses in penetration were 37,000 meters. Considering that hole depths have risen greatly during this five-year plan, the remediation of accidents requires great expenditures of both time and material resources.

3. The share of wells eliminated for technical reasons is substantial. During the 10th Five-Year Plan 48 deep holes were eliminated, the total cost of which was 73 million rubles, and the penetration was 159,000 meters. The elimination of holes for technical reasons, aside from the purely financial and material losses, often delays the completion of various geological tasks and increases the time spent prospecting for and exploring fields, which, after all, reduces the geological and economic effectiveness of prospecting and exploration.

4. Such promising areas as the Beshkent, Zaunguz, Karabekaul and Ilim trough were not covered by the operations because of the uneven siting of key and appraisal holes on the republic's land. This is explained by the fact that key and appraisal holes are drilled only by the Turkmen SSR Geological Administration and Turkmenneft' Association, which concentrate their work in the areas of their activity, a fact that is completely justified even from the economic point of view. The opinion that drilling key and appraisal holes on the republic's land should be done by the UG [Geological Administration] of the Turkmen SSR is wrong and does not meet today's requirements, for the following reasons: UG TSSR does not have drilling organizations in the regions where such holes must be drilled; and the establishment of drilling organizations in these regions for drilling 2-3 key and appraisal holes is uneconomical. Because of this, such holes should be drilled by the nearest drilling organization, regardless of its agency subordination.

5. The sequence in stages of the geological-exploration cycle is being violated. Thus, for example, prospecting and exploratory drilling were done first in the Uchadzhi region (Uchadzhi, Kulach and Vostochnoye Uchadzhi) and then an appraisal hole (Yashlar) was drilled. In the Beshkent petroliferous area, in the eastern part of the Ciskopetdag petroliferous region, prospecting and exploratory drilling was started without the preliminary drilling of appraisal holes.

6. The geological effectiveness of key and appraisal holes is reduced considerably because of inadequate drilling depths: their average depth is less than that of prospecting and exploration holes. Of 50 key and appraisal holes made during the past 10 years, only 7 were more than 4,000 meters deep.

7. A portion of the structures found and prepared prior to the period being analyzed is located on lands which, as a result of drilling, have been evaluated as unpromising or poorly promising. On the one hand, this indicates that second-stage work--detailed prospecting (the discovery and preparation of structures)--was performed in these areas ahead of schedule, without a preliminary assessment of the prospects that the land or a complex of sediments was petroliferous (which is the job of key and appraisal drilling). On the other hand, this raises such questions as establishment of the speed of discovery and preparation of structures as a function of the results of regional operations. It is hardly desirable to promote detailed prospecting without obtaining commercial flows of hydrocarbons at the regional-operations stage. When the results of drilling are positive, the matter of the optimal number of structures to be reprepared also is urgent. Over the years, the accuracy and intensity of geophysical research have been increased through the use of new geophysical equipment and work methods. This leads to reparation of structures. Thus, for example, some of the structures prepared by MOV's [reflected wave methods] in previous years (Yalany, Bayram-Ali, Severnyy Chesme, Yuzhnyy Unguz and others) were reprepared by the expensive OGT [common depth point] method because of incompleteness of the data on the subsalt portion of the profile and incompleteness of their introduction into development. Reparation of a large number of structures in East Turkmenistan by the OGT method is also planned for deep horizons over the long term. Therefore, in areas of petroliferous promise at which petroliferousness has been proved and where there is an existing, adequate inventory of prepared structures, the main task of the detailed prospecting stage is the maximum discovery of local uplifts.

8. The low coefficient of successfulness in deep drilling testifies that validation of the prospects of structures that are recommended for drilling and the quality of hole penetration and of sampling must be improved. The practice of going to work in areas not prepared for drilling (Seytli, Shokhrat, Yalkym, Khumly, Davali, and so on) affects adversely the coefficient of success.

In recent years it has become the practice to proceed with drilling at a promising area with two or even three rigs. Such an approach has both positive and negative aspects. The large number of rigs speeds up assessment of a structure's promise of petroliferousness. But on the other hand, a larger number of holes is used to obtain negative results for the assessment.

Going to work in an area with several rigs occurs, for example, in the Murgab depression. All the known fields here are now associated with sandstones of the Hauterivian (the Shatlyk horizon), and all of them are single-formation fields. The structures are simple, as a rule, uncomplicated by tectonic disturbances. Of 27 structures drilled over within the Murgab depression, 15 proved to be fields and 12 were unpromising for the "Shatlyk horizon." And all the fields were discovered by the first hole (table 2). The Mayskoye and

Table 2

The Number of Holes for Evaluating a Structure  
in the Murgab Oil and Gas Bearing Area

Designation of the field	Number of holes	Barren structures	Number of holes
Mayskoye.....	3	Repetek.....	3
Bayram-Li.....	3	Severo-Bayram-Li.....	1
Sharapli.....	1	Maryy.....	3
Keliy.....	1	Tarkhan.....	1
Yelan.....	1	Vostochno-Yelan.....	3
Shakhitli.....	1	Iolatan.....	2
Dzhudzhukli.....	1	Yuzhno-Iolatan.....	5
Mollaker.....	1	Karakel.....	4
Tedzhen.....	1	Saryyazy.....	1
Vostochno-Tedzhen.....	1	Sandykachi.....	1
Donmez.....	1	Yulduz.....	4
Uchadzhi.....	1	Kulach.....	3
Shorkel.....	1		
Seyrab.....	1		
Beshkizil.....	1		

Bayram-Li fields are exceptions. This anomaly is explained by the fact that these areas were the first targets introduced to deep drilling. Information about the geological structure and petroliferousness when drilling was organized was not great. The drilling of two, three, four and five holes at the remaining structures did not lead to any discoveries at all. That means that when evaluating the productiveness of structures in the Murgab depression for the "Shatlyk horizon," one, or a maximum of two prospecting holes is sufficient. Working an area with one rig holds back prospecting progress. A variant whereby 2-3 holes are sunk simultaneously at the structure, provided that at least one is sunk into the underlying Callovian-Oxfordian and, to the extent possible, also into the Lower and Middle Jurassic sediments, can be an alternative to this. Considering that the potential reserves of the Upper Jurassic carbonate sediments of the Murgab depression are great (this is confirmed by commercial flows of hydrocarbons at the Sandykachi and Yashlar areas), the probability of finding fields under such an arrangement is doubled. Aside from this, performing this work will enable geological information about these sediments to be obtained. This can serve later in substantiating the conduct of prospecting at them. This route is the most optimal one at present.

Thus, elimination of the indicated deficiencies and negative factors in operation of the republic's drilling organizations is a considerable reserve for increasing labor productivity and the geological and economic effectiveness of prospecting and exploration.

#### Conclusions

Oil and gas operating effectiveness can be raised by the rational siting of key and appraisal holes, an increase in their depth, and observance of the prescribed stages for geological exploration, and also by realization of reserves that are available for deep drilling.

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## OIL AND GAS

### WEST TURKMENIA DEPRESSION POSSIBLY PETROLIFEROUS

Ashkhabad IZVESTIYA AKADEMII NAUK TURKMENSKOY ASSR: SERIYA FIZIKO-TEKHNICHESKIKH, KHIMICHESKIKH I GEOLOGICHESKIKH NAUK in Russian No 3, 1984 (signed to press 10 Aug 84) pp 62-65

[Article by V. F. Borzasekov and S. I. Gusarova (TurkmenNIGRI [Turkmen Scientific-Research Institute for Geological Exploration]): "The Hydrodynamic Characteristics of the Main Areas of Oil and Gas Accumulation of Southwest Turkmenistan"]

[Text] As is known, the forming and the destruction of oil and gas deposits in the ground are linked with an aqueous environment and are caused to a great extent by the dynamics of the ground water, so a study of the hydrodynamic environment is of great practical importance in identifying regional zones of oil and gas accumulation.

In accordance with the results of geological, hydrogeological and geochemical research in the West Turkmen depression, three main zones of oil and gas accumulation are singled out there which are confined to the Balkhan and Gograndag-Okarem uplift zones and to the lands of the Kyzyl Kum trough.

The West Turkmen depression is complicated by thick Neogene and Quarternary sediments. Four petroliferous complexes are singled out in the profile of Neogene sediments: the lower red beds, the upper red beds, the Akchagylia and the Apsheronian [5 and 6].

Questions of the modern dynamics of Pliocene sediment ground water have been examined by many researchers and become controversial. Such researchers as Yu. V. Dobrov, G. A. Borshchevskiy, M. Ye. Al'tovskiy and others, based upon the common hydrogeological concept of the existence of a West Turkmen artesian basin, noted water movement throughout the Mesozoic sediments complex, from south to north, from the fold-mountain fringe to the Balkhan uplift zone, where the waters had been introduced into Pliocene sediments through a system of fractures [1 and 3-6].

In studying the hydrodynamic regime of Pliocene sediments of the West Turkmen petroliferous area, V. V. Kolodiy [5] established the presence of an elision-type water drive system throughout the whole history of the hydrogeological development of the area being examined. Schemes of the paleohydrodynamic

environment and the modern dynamics of the ground waters of the Middle Pliocene sediments that formed them emphasize the fall in heads from the area of maximum sag to the periphery of the West Turkmen depression, from the Caspian's water area to the fold-mountain fringe. V. V. Kolodiy's schemes are based upon calculations of the pressures at one point for each area, so they reflect only the regional nature of the changes in heads, without emphasizing the local peculiarities of the hydrodynamic regime of each structure.

Based upon a large amount of factual information, we called for a study of the modern hydrodynamic conditions of Pliocene-sediment petroliferous complexes in connection with the forming of the oil and gas deposits within the West Turkmen depression. In order to determine the modern hydrodynamic conditions, the nature of the distribution of formation pressures within each structure and for each water-bearing complex was analyzed. Hydrodynamic maps of two kinds were compiled: of the piezometric surface and the piezometric levels (according to A. I. Silina-Bekchurin's method), which enabled the modern hydrodynamic peculiarities of the water-bearing complexes to be found. Both types of maps proved to be identical in terms of the nature of the distribution of heads in the water-bearing complexes. Because of this, the modern hydrodynamic conditions of Southwest Turkestan Pliocene sediments are illustrated only by maps of the piezometric surface.

During the construction of such maps, the position of the piezometric level was computed at each observation point in accordance with the formula  $H = 10P_{\text{пл}} \text{ s.f.}$ , where  $H$  is the absolute grade of the piezometric level (in meters);  $P_{\text{пл}}$  is the formation pressure (Pa); and s.f. is the absolute grade of the middle of the filter (in meters).

The lower red beds water-bearing complex, according to the map of the piezometric surface, is marked by a regional reduction in head from the area of maximum sag to the periphery of the depression (figure 1). Toward the north and west edges of the basin, the grades of the piezometric surface are reduced to 400 meters and lower. The western part of the Kelkor trough is singled out by a regional rise in the piezometric surface (more than 1,200 meters). The edaphic piezominima are recorded at Balkhan uplift zone (Cheleken and Koturtepe) and Erdekli area structures, the piezomaxima at Kuydzhik-Boyadag and Gograndag structures. A characteristic feature of the hydrodynamic environment of the lower red bed water-bearing complex is the length of the high-pressure zone far beyond the limit of the modern Kyzyl Kum trough right up to the eastern closure of the Balkhan uplift zone.

Basically the same general hydrodynamic-environment features that are characteristic of the lower red beds are characteristic also of the upper red bed water-bearing complex (figure 2). In the regional layout, a reduction is noted in the piezometric surface from the area of the maximum sag (the water area of the Caspian and the Kyzyl Kum trough), where the piezometric levels are maximum (more than 900 meters), to the northern and eastern peripheries of the West Turkmen depression (less than 100 meters). The area of the Kelkor trough also is singled out by a zone of relatively high values for the grades of the piezometric surface (more than 500 meters). On the map of the piezometric surface, voluminous piezominima cover the Cheleken-Koturtepe and

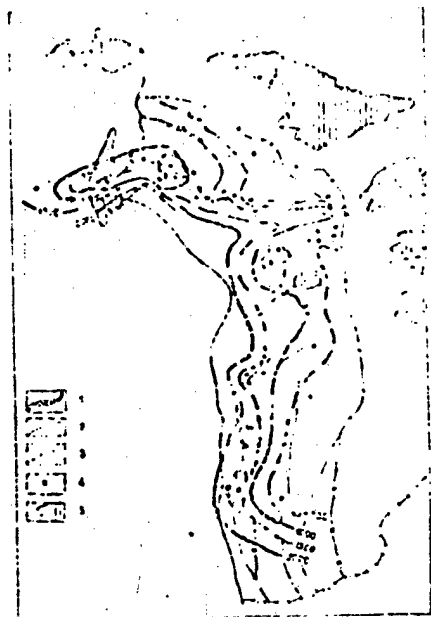


Figure 1. Schematic Map of the Piezometric Surface of the Lower Red Bed Water-Bearing Complex:

1. Isolines of the water-bearing complex's piezometric surface.
2. Tectonic dislocations.
3. Edge of spread of the water-bearing complex.
4. Holes at which the piezometric levels were computed.
5. The fold-mountain fringe.

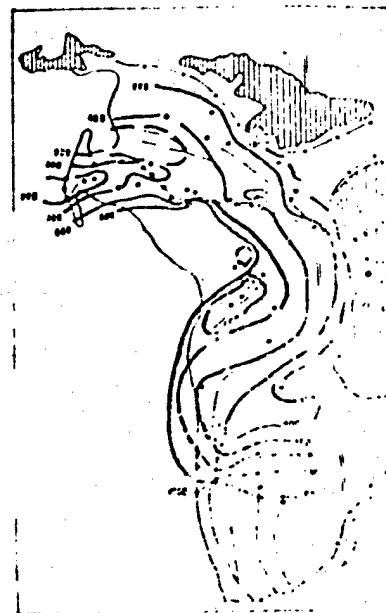


Figure 2. Schematic Map of the Piezometric Surface and the Upper Red Bed Water-Bearing Complex (the conventional signs are the same as for figure 1).

Gograndag-Karadashly areas, and edaphic piezominima are recorded also at the Monzhukly and Erdekli structures. A characteristic feature of the upper red bed water-bearing complex is the growth in values of the heads in the southern direction.

The Akchagylian water-bearing complex also is marked by a consistent lowering of the piezometric surface, from the area of maximum sag to the depression's periphery (figure 3). Edaphic piezominima are recorded on the piezometric surface only at the Koturtepe structure. Also for this complex, the Kelkor trough is singled out by a zone of increased values for the grades of the piezometric surface (more than 400 meters).

An analysis of the maps that characterize the modern hydrodynamic situation of all the water-bearing complexes will enable the following conclusions to be drawn.

Figure 3. Schematic Map of the Piezometric Surface of the Akchagyl'ian Water-Bearing Complex (the conventional signs are the same as for figure 1).

1. The West Turkmen petroliferous basin, in the modern hydrodynamic environment, is an elision water-head system, the drop in heads in which trend from the areas of maximum sag to the basin's periphery and to the area of the fold-mountain fringe.

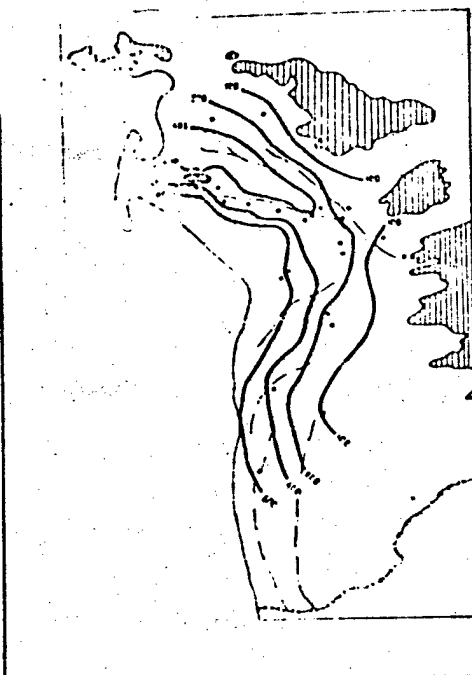
2. The piezominima that have been found within the various folds of the Balkhan and Gograndag-Okarem regions (Cheleken, Kotur-tepe, Monzhukly, Erdekli, Gograndag, Karadashli and, probably, others) testify to the discharge of fluids from this complex into the overlying sediments. The piezomaxima recorded (Kuydzhi, Boyadag, Gograndag, Okarem and Keymir) point to the penetration of fluids into this complex from underlying sediments.

3. Throughout the three water-bearing complexes (the lower red beds, the upper red bed and the Akchagyl'ian), the Kelkor trough is singled out by a regional zone of higher heads, which can indicate an additional source of fluids that move toward the Balkhan uplift zone.

4. In accordance with the hydrodynamic characteristics of the water-bearing complexes in the lands of the West Turkmen depression, the following regions are singled out: the Kyzyl Kum, which includes the water area of the Caspian and the Kyzyl Kum trough, with the maximum values of the heads that are characteristic of them; the Balkhan and Gograndag-Okarem, within which edaphic piezominima and maxima have been observed that testify to a vertical cross-flow of fluids between the water-bearing complexes; the Kelkor, which is located within the trough and the depression's northern side, which is adjacent to it, and is characterized by a regional piezometric positive anomaly in the trough and by a consistent fall in the value of the head in the direction of the mountain structures of the Kubadag and the Bolshoy Balkhan; and the Shakhman, which embraces the eastern periphery of the depression between the Gograndag-Okarem and the Aladag-Messierian uplift regions and is characterized also by a consistent reduction of heads in the direction of the fold-mountain fringe.

An assessment of prospects that Pliocene sediments are petroliferous is based upon an analysis of the hydrodynamic regime over the course of the entire history of the West Turkmen depression's hydrogeological development.

Reconstruction of the paleohydrogeological environment of the West Turkmen depression permits the assumption that favorable conditions for the forming of hydrocarbon accumulations in Pliocene sediments existed during the whole history of the hydrogeological development of the area being studied. The paleohydrogeological conditions were characterized by a drop in heads from the area





of maximum sagging toward the periphery of the depression. Within the Balkhan and Gograndag-Okarem uplift zones, edaphic paleopiezominima and minima of squeezed-out water were found, which indicate processes of hydrocarbon accumulation. The modern hydrodynamic conditions of Pliocene deposits also are favorable for forming and preserving hydrocarbon deposits. For petroliferous complexes, the drop in head trends from the area of maximum sag (the generation of hydrocarbons) to the Balkhan and Gograndag-Okarem areas of oil and gas accumulation, within which there are local piezominima and active mud volcanoes, which are viewed as agents for the vertical crossflow of hydrocarbons.

Analysis of the hydrodynamic situation for the forming and distribution of hydrocarbon deposits within the West Turkmen depression indicated that traps of the Kyzyl Kum, Balkhan and Gograndag-Okarem regions should have the best prospects for petroliferousness.

The piezominima of the Balkhan and Gograndag-Okarem uplift zones, which have existed for a long time, probably were a barrier for the further lateral migration of hydrocarbons from the area of maximal sag of the depression. In this connection, the discovery of new oil and gas fields in Pliocene deposits of the West Turkmen depression (the Kelkor and Shakhman regions) edge zones is possible in areas with favorable conditions for the vertical crossflow of fluids from underlying sediment complexes.

#### Conclusions

1. The characteristics of the hydrodynamic environment of the main zones of oil and gas accumulation in Pliocene sediments of Southwest Turkmenistan have been discovered.
2. An evaluation of the prospects for petroliferousness of the territory has been given in accordance with hydrodynamic criteria.

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## OIL AND GAS

### SUGGESTIONS FOR CASPIAN OIL OUTPUT INCREASE CITED

Alma-Ata NARODNOYE KHOZYAYSTVO KAZAKHSTANA in Russian No 7, Jul 84 pp 28-29

[Article by A. Derepaskin, chief of the Department of Supervision in the Oil and Gas Extracting Industry and Geology of Gosgortekhnadzor [State Committee for Supervision of Safe Working Practices in Industry and for Mine Supervision] of Kazakh SSR, and G. Larin, chief engineer of the Western-Kazakhstan Okrug of the KaSSR Gosgortekhnadzor: "On the Road to the Riches of the Caspian Basin"]

[Text] The 26th CPSU Congress has demanded the implementation of measures for the discovery of new oil and gas deposits in the KazSSR region, and the attainment of annual oil recovery levels for the republic of up to 30 million tons. To this end, the volume of geological and geophysical and exploratory operations has been sharply increased in the Western Kazakhstan region, especially in the Caspian basin.

As a result, the Astrakhan, Karachaganak, Zhanazhol, Tengiz and other oil and gas, and oil and gas condensate fields were discovered. Oil and gas accumulation areas shaped like a relatively narrow wheel with a diameter of about 100 km have been discovered within the most elevated banked areas of the Caspian basin, and encircling the region of the oil- and gas-bearing basin. In addition to the already discovered fields, there are still many promising areas within the wheel where exploratory operations can be carried out.

In 1982 a state commission of experts reappraised potential hydrocarbon reserves. As a result, the figure for reserves at depths of up to 5 km turned out to be 12 percent greater than previous estimates, and expected reserves for depths of up to 7 km have been increased by 2.5-fold. This stimulates further expansion of the exploration and prospecting operations front.

A significant increase in total reserves of hydrocarbon resources is foreseen in the Caspian basin during the 11th Five-Year Plan.

We know that geophysical operations play an important role in oil and gas exploration, and that first among them is seismic survey. It gives very good results in areas where the strata occur relatively orderly or slope gently. But in the Caspian basin the rock formations have, because of the

salinized tectonics, steeply dipping, and occasionally vertical interfaces. Seismic survey quality is noticeably lowered, especially when studying deep-seated, so-called sub-salt deposits, which are the richest in hydrocarbons.

So the mineral prospectors were faced with the insuperable problem of the reliability of their data. This puts the problem of accelerating development of new methods of voluminous seismic survey, and the establishment of seismic instrument stations with 200 and more channels before the scientific organizations and industrial workers of the USSR ministries of geology and the petroleum industry. The assimilation into practice of high-resolution seismic survey makes possible a re-creation not only of a geometric map of the structure and mutual distribution of strata, but also a determination of their properties and qualitative composition.

Geophysicists have great opportunities for a long-range study of the geological section with the help of electromagnetic prospecting. Unfortunately, this method is not seeing growth, though in our situation it would be inestimably profitable.

We consider the acceleration of the development and assimilation into practice by geophysicists of a method of electromagnetic survey, using high-energy sources, to be of utmost importance. With its help we will be able to determine collecting properties and distinguish porous, high-capacity strata, and even the low-capacity strata which occur at depths of up to 10 km.

The rapid growth of geological and exploratory operations is accompanied by an increase in their volume. During the 10th Five-Year Plan, 1,835,000 meters were drilled in the Caspian oil-producing province. Rates are increasing during the 11th Five-Year Plan. However, drilling is being carried out in difficult geological conditions in the mountains. Among other things the plastic fluidity of the salt-bearing deposits and the clays of the Lower Permian deposits render the flow strings inoperative, seize up the drilling tools and lead to other breakdowns.

In the Caspian, wells are now completed by construction, for the most part at depths of 4-5 km. But according to predicted estimates 70 percent of the oil and gas reserves are concentrated at depths of 5-7 km. However, our domestic industry is not yet manufacturing rigs capable of drilling to such depths.

To keep from inhibiting the development of geological and exploratory operations, the USSR Ministry of Heavy Machine Building should organize construction of rigs for drilling to depths of 6-7 km and more.

During exploration operations logging sondes, bottom-hole pressure gages, thermometers, sampler units and other instruments must be lowered into the wells to determine the characteristics of the oil-bearing strata. But formation pressure and temperature increase with depth. For this, a heat- and pressure-resistant instrument, designed for formation pressures of up to

100 mPa and temperatures of up to 200°C, is required. Up to now such an instrument has not yet been put into series production, since operations have not been carried out in oil-producing regions with pay zones occurring at such depths.

The government has charged the Ministry of Chemical (and Petroleum) Machine Building USSR [Minkhimmash] with implementing the development and manufacture of wellhead equipment, tools and instruments for downhole operations in fields with abnormally high formation pressure and temperature. But for now we have to use imported instruments.

Hydrogen sulfide and carbon dioxide present serious difficulties for geologists and drillers. These gases are contained in the associated and natural gas of subsalt deposits. The maximum allowable concentration of hydrogen sulfide in the air of a work area is 10 mg/m<sup>3</sup>, and up to 0.008 mg/m<sup>3</sup> in populated areas. At higher hydrogen sulfide concentrations drilling equipment and instrumentation, in normal use, is quickly damaged. This can lead to major breakdowns and blowouts.

The degree of danger from oil-gas blowouts can be assessed on the example of the newly discovered Tengiz oil field, which is characterized by an abnormal formation pressure of up to 90 mPa, a gas content of up to 600 m<sup>3</sup>/t and hydrogen sulfide content in excess of 20 percent (by volume) in the associated (wellhead) gas.

For work in Tengiz-type fields, we need equipment, tools and instrumentation of a special corrosion-resistant design which our domestic industry does not manufacture. This forces oil- and gas-extracting enterprises to acquire them abroad.

The scarcity of corrosion-resistant drill pipe, casing pipe, oil well tubing and blowout preventer equipment is felt sharply in fields with high hydrogen sulfide content. Drilling rigs in such fields have no automatic gas analysers for hydrogen sulfide and are insufficiently provided with hydrogen sulfide neutralizing additives for drilling mud.

In 1974 the USSR Ministry of Geology [Mingeo SSSR] and the Ministry of the Petroleum Industry [Minnefteprom] approved quotas for equipping deep-well drilling rigs with mechanisms, devices and instruments to increase safety. However, at many sites these allocations have not yet been fulfilled, or have been incompletely fulfilled. Devices which shut off drilling mud pumps when maximum allowable pressure is reached in the mud injection line, devices for the automatic refilling of wells during hoisting of drill tools and appliances for drying air in pneumatic system connections etc., have not been developed nor are they in series production.

Other equipment, such as explosion-protected 12-volt portable hand lamps, an intercom between the driller's position, the derrickman's platform and the pump house, a device for hoisting workers up to the various derrick platforms, torque meters for making up drill pipe and casing threads, a traveling cradle for the derrickman, centralizers for lowering in casing strings

and many other devices, have all been accepted for series production and are badly needed by the enterprises, but are not being manufactured. The fact is, that the ministries did not attend to the prompt distribution of orders to plants.

The non-provision of series instruments and equipment to the drilling enterprises makes necessary the fashioning of a variety of homemade devices which do not give desired results and do not guarantee safe work because of nonconformity to established standards.

It is high time for Mingeo USSR and Minnefteprom USSR to review the quotas for equipping drilling rigs with instruments, equipment and mechanisms, and to take the necessary measures for their certain manufacture and delivery to the drilling enterprises.

Over 20 production and scientific and research collectives of three Union ministries--Mingeo, Minnefteprom and Mingazprom are participating in the realization of the program to speed up the growth of regional geological and geophysical, and geological and exploratory operations in the Caspian. Of them, nine are geophysical and eight are drilling collectives.

It seems to us that the time has come to examine the problem of an efficient organizational structure and a system of administration with all types of oil and gas operations in the Caspian basin similar to that which was solved during exploration and operation of the Western Siberian field.

We need to set up two main administrations for the Western Kazakhstan region: one for exploration of oil and gas fields, and the second for recovery. Already existing oil and gas exploration and recovery associations are harmoniously joining ranks in these administrations.

Resolution of the indicated problems will further the fulfilling of tasks to develop the oil and gas industry in Western Kazakhstan.

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12659

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## OIL AND GAS

### OILFIELD MECHANIC SHORTAGES DISCUSSED

Ashkhabad TURKMENSKAYA ISKRA in Russian 14 Aug 84 p 2

[Article by D. Khodzha-Mukhammed, senior instructor, Turkmen Polytechnical Institute Department of Oil and Gas Field Development: "Problems and Opinions. Who Is to Maintain Equipment?"]

[Text] The Turkmen Polytechnical Institute [TPI] is a basic educational institution for graduating engineering personnel for the republic's oil and gas industry. During its 23 years, the petroleum department has trained a huge number of petroleum engineers, drillers, gas workers and hydrogeologists who are successfully working in the gas and oil fields, scientific and research and planning institutes and in other organizations of the republic.

One of the main demands made on specialists of a given field is a thorough knowledge of equipment. A great number of machines and equipment are used in the process of exploration, development, extraction, and storage and transport of oil and gas, including equipment for flow, compression and downhole pumping methods of petroleum extraction, for hydraulic formation fracturing, underground repair and sealing of wells etc.

And this is far from a complete list of equipment used in oil and gas field development. Improved and powerful equipment is utilized in the exploration, drilling and extraction of oil and gas as productive horizons occur at increasing depths. In connection with this, the question of the skilled putting into operation of all this equipment, its competent assimilation, and carrying out preventive and scheduled repairs and other operations, taking climatic and geographic conditions into consideration, takes on special importance.

Otherwise the equipment breaks down prematurely, production efficiency is reduced and recovery levels decrease. Unfortunately, this has increased in frequency lately. The reason for this is a shortage of specialists to service equipment and mechanisms.

There is no plan to train engineers for a profession in "Machines and Assemblies of the Oil and Gas Industry" at the TPI. Nor are other VUZ's of the republic graduating them. As a rule, we hire mechanical engineers from the graduates of the Moscow Oil, Chemistry and Gas Industry Institute imeni

M. M. Gubkin, the Azerbaijan Oil and Chemistry Institute imeni A. Avizbekov and the Ivano-Frankovskiy Petroleum Institute.

Unfortunately, as practice has shown, the young specialists, in the best of cases, depart for home after the prescribed time. At worst, they, under various pretexts, do not even show up at their assigned locations.

In a word, the problem of major gas- and oil-extracting, and petrochemical enterprises and petroleum machine construction plants supplying mechanical engineers is still unresolved today, a situation which has a destructive effect on production.

By way of illustration, as A. K. Firsov, chief engineer of the Ashkhabad Petroleum Machine-Building plant informed us, in the shops of this enterprise, workers of other professions work as mechanics. And even Ashneftemash [Ashkhabad Petroleum Machine-Construction Plant] is being modernized. Its capacity will increase approximately two-fold. As a consequence, demand is increasing in the engineering force. And a similar situation exists in other enterprises.

However, as has already been said, there is no plan, as before, to train engineering personnel in the mechanical disciplines. Meanwhile, the Turkmen Polytechnical Institute's Petroleum Department seems to be capable of realizing the assignment. A collective of highly-qualified instructors and scientists works here.

The problem of opening a new department in the TPI requires a rapid solution. The higher school and the national economy of the republic await substantive word from Gosplan TSSR, which has precise information on the future demands for specialists in the above-named skills up to 1990.

12659

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## OIL AND GAS

### ESTABLISHMENT OF LABOR SAFETY ASSOCIATION SUGGESTED

Baku VYSHKA in Russian 10 Aug 84 p 2

[Article by Yu. Ismaylov, head of the Kaspbureftegazprom [Caspian Drilling and Oil and Gas Industry] Industrial Hygiene and Safety Department, "The Matter Is Urgent"]

[Excerpt] Baku--Offshore drilling is conducted under specific conditions, differing from footage drilled ashore. Special demands are also made regarding the observation of safety rules. Much work has been done in our association's enterprises to prevent production accidents and improve working conditions.

Our primary emphasis is on providing drill sites with modern safety equipment. Thus, in 1983, 811 thousand rubles were spent on these measures rather than 457.6 thousand, i.e., almost twice what was planned. Twenty sets of automatic drilling tongs, 17 pneumatic power slips, 27 cantilever revolving cranes, 23 electric telfers and a lot of other equipment has been acquired and installed on production facilities. Just as much attention is being given in the associations to the mechanization and automation of such labor-intensive processes as the charging and treatment of drilling mud etc. Last year, 544 thousand rubles were spent on this, against the planned amount of 312.6 thousand. The implementation of measures to lower the noise level, improve lighting on the facilities and provide normal working temperatures are characterized by excellent indicators. This year we have set before ourselves the major tasks of providing offshore drilling personnel with healthy and safe working conditions. In 1984, an integrated plan was worked out for which 590 thousand rubles was allocated. This amounts to one-third more than in 1983.

Strict control over their observation is helping us to maintain a steady reduction in the number of safety rule violations. Thus, in 1983, for laxity in industrial hygiene work, disciplinary fines were levied on 180 association employees. Proceedings were instituted against 19 of them and 83 of them were deprived of bonus pay increases.

Unfortunately, we still have quite a few hindrances.

One of the main hindrances is a shortage of qualified industrial hygiene specialists. Indeed, it is no secret that not a single VUZ in the country is training engineers for this challenging skill. And occasionally you have people occupying this responsible position who have insufficient knowledge of the field. Another problem is that administrators of drilling enterprises, while focusing primarily on fulfilling drilling footage quotas, occasionally spend little time thinking about the responsible organization of the industrial hygiene department.

Tens of enterprises are members of the Kaspburneftegazprom Association, but offices of labor safety practices have been organized only in the Sangachaly MUBR [Offshore Administration of Drilling Operations], the Maritime MURB [Offshore Exploratory Drilling Administration] and the First Technological Transport Administration. But in fact, in accordance with an association order, these offices are to be set up in each enterprise.

Of course, it would have been possible to get partially out of the situation, had we had a mobile labor safety practices office, such as exist in many other areas of the country. This one-of-a-kind laboratory on wheels, equipped with film projection equipment, tape recorders and other equipment would be a great help to us in the wide propagation of advanced methods and techniques of labor safety. This question, which we put before the management of the Kaspburneftegazprom VPO [All-Union Production Association] is still unresolved.

We still have trouble in that many needed scientific and research developments in the field of industrial hygiene are not being assimilated in production. Among these, for example, is the intercom unit, devised many years ago in the VNIItsekhniky bezopasnosti [All-Union Scientific and Research Institute of Labor Safety Practices], which should be installed at the drillers station. Use of these units would be very helpful in reducing the number of industrial accidents.

About a year ago an article on this subject was published in VYSHKA by VNIITB [All-Union Scientific and Research Institute for Labor Safety Practices] specialists. The article's authors wrote that it was unprofitable to many plants and manufacturers to begin production of new labor safety devices or appliances for the reason that they, as a rule, they require that new machining attachments be devised, they have a low specific quantity of metal per unit, and low production cost etc. In addition, these specialists think that there is a way out of the situation. The whole circle, from research and development to the production of new safety equipment, must be closed. In other words, a new scientific and production association must be set up. In our view, this would be the correct solution to the problem. But so far, as far as we know, there has been no progress in this matter.

12659

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## OIL AND GAS

### ORENBURG PREPARES FOR KARACHAGANAK GAS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 1 Aug 84 p 1

[Article by I. Payvin, personal SOTSIALISTICHESKAYA INDUSTRIYA correspondent, "A Gas Workers' Shift Team"]

[Excerpt] Orenburg--For eight years running, the Orenburggazprom [Orenburg Gas Industry] All-Union Industrial Association has held the CPSU Central Committee, USSR Council of Ministers, VTsSPS [All-Union Central Labor Union Council] and the VLKSM [All-Union Komsomol] Central Committee Red Challenge Banner. Ten years have passed since this gas-condensate field came into operation, and during this time 400 billion cubic meters of gas have been recovered. For 38 quarters the association has been awarded first place in the industry, only once dropping to second place. Now they have again taken on exacting obligations to recover 900 million cubic meters of above-plan gas.

At the field, in addition to the plant, the collective has custody of 64 wells, a fairly large operation. Right now there are 43 people at this field, where there used to be twice as many. Cutbacks in maintenance personnel have helped raise people's skill levels, assimilate related skills and introduce the brigade form of labor organization.

At the entrance to the plant grounds grow sturdy apple trees, filled with sun-ripened fruit. A little farther on, beyond a fence, there is a half-hectare of garden. I mention this to point out that before, when the idea for these fields was conceived, the opinion was expressed that not only would trees not grow, but neither would grass. However, reliable sealing of the equipment prevents air pollution, and now this place is ablaze with the whiteness of apple blossoms in the spring, and by autumn the fruit ripen. Cleanliness is being kept up at the other fields too, and they also have greenery planted.

"Of the 11 installations in the gas-refining complex," says N. Galyan, Orenburggazdobycha [Orenburg Gas Recovery] Association director, "today it would be difficult to single out the best. It would be more correct to say of all of them straight off, that the association has recovered 689 million cubic meters of gas above the plan in the last six months. Obligations have also been exceeded for growth in labor productivity. Instead of 2.1 percent, 2.5 percent was achieved. Production cost of commodity production has been lowered

1.9 percent.

Repair, supply and transport services have been centralized using the VAZ [Volga Automobile Plant] method. The brigade form of labor organization has been introduced in many sectors. All this has produced a considerable savings in equipment, the maintenance personnel force has been reduced and quite a few field personnel have cross-trained into new industries.

It is acceptable to call the Orenburg gas complex "giant". And so it is. Today, five associations and nine other major subdivisions are members of the Orenburggazprom Association. They are involved in drilling, recovery, shipment of output and repair. One of them, Orenburggazzavody [Orenburg Gas Refineries], is the center of the entire complex and symbolizes in itself the vigor of the industry and the achievements of engineering thought. How are things there?

The chief concern at the gas refinery is to bring the raw materials into the necessary condition and extract their valuable components.

These days the enterprise is carrying out a sound program of equipment rebuilding. As it turns out, the complex is preparing to take on gas and condensate from Karachaganak. This is a new, unique field, which has been discovered in the neighboring Ural Oblast, and where they are now developing the mineral resources. Six drilling brigades have left the association to go there. Drilling is a challenge there, with well depths of 5,500 meters. Gas from this underground storehouse should be flowing into the pipeline for refining in Orenburg by October of this year.

12659

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## OIL AND GAS

### BRIEFS

**OILWORKER'S HISTORY, WORK RECOUNTED**--After the army, having graduated from the Chernogorsk Technical School, Young Communist Leaguer Vyacheslav Katanov began working as a driller in a Talnakh geological and exploratory party. After a short time he mastered the new equipment and deep-well drilling technology. At present his shift is drilling in the Talnakh polymetallic ore field, serving as an example of skillful, selfless labor. Katanov's shift was one of the first engaged in the mineral prospectors' competition for a worthy greeting to the 40th anniversary of the Victory. [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 16 Aug 84 p 1] 12659

**FIRST ADYGEYSKAYA WELL OPERATING**--Maykop--The first well drilled in the recently explored Western Voznesenskoye gas field has begun production. It produces 20 thousand cubic meters of gas and 50 tons of gas condensate daily. Both types of fuel are characterized by high quality. For example, the condensate is to be used in the manufacture of highest-quality gasolines. Mineral exploration of the Adygeyskaya Autonomous Oblast goes on. It is showing promise here for the occurrence of oil and gas. [By Yu. Semenenko] [Text] [Moscow SEL'SKAYA ZHIZN' in Russian 14 Aug 84 p 1] 12659

**ASSOCIATIONS' RECOVERY LEVELS CITED**--Almetyevsk--Tatneft' Association workers have recovered 300 thousand tons of above-plan oil since the beginning of the year. All the oil- and gas-extracting administrations have put their contributions in for a collective success, but the largest share of the additional recovery is due to the Al'met'evneft', Aktyubaneft', Dzhailil'neft' and Prikamneft' collectives. [By U. Bogdalov, SOTSIALISTICHESKAYA INDUSTRIYA personal correspondent] [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 1 Sep 84 p 1] 12659

**BOILER FURNACES OIL-FUELED**--Cherdyn, Perm Oblast (TASS)--The well, which has a total daily output of 7 tons and was put into operation near the small Ural city of Cherdyn, turned out to be efficient. The oil is replacing coal, which had to be shipped long distances, in boiler furnaces. In the Kama region, all low-yield wells have been registered. Recovery from these wells will increase 6-fold by 1990. [Text] [Baku VYSHKA in Russian 4 Sep 84 p 1] 12659

**ASTRAKHAN DEVELOPMENT WELL OPERATIVE**--A commercial inflow of gas and condensate has been obtained from the first development well in the Astrakhan gas-condensate field. [Text] [Moscow EKONOMICHESKAYA GAZETA in Russian No 37, Sep 84 p 3] 12659

COMPRESSOR STATION STARTUP ANNOUNCED--Nizhnevartovsk, Tyumen Oblast--Start-up and adjustment work began on the Samotlor oil field's KS-3 gaslift compressor. Putting this station into operation will increase the influx of oil from almost 500 wells, and more effectively utilize the associated gas. [Text] [Baku VYSHKA in Russian 18 Aug 84 p 1] 12659

SANGACHALA DRILLERS BEAT DEADLINE--Baku--The drilling crew from the Sangachala MUBR [Offshore Administration of Drilling Operations], headed by drilling foremen Aliovsad Ragimov and Tel'man Suleyman, have completed about 20 thousand meters of footage from their steel platform in the Duvannyy-more field, all during the present five-year plan. Having fulfilled the fourth-year plan for footage drilled ahead of schedule, the brigade has already drilled more than 200 meters beyond the Caspian sea floor bottom, to be entered on the 1985 accounting. Completion well No 453 daily pumps out tens of tons of oil into NGDU [Oil and Gas Extraction Administration] imeni USSR 50-th Anniversary storage tanks from a depth of 5,140 meters. Meanwhile, the drillers have started drilling a new well--No 461, with a projected depth of 4,000 meters. Though less than three months have passed since they began drilling this well, the drilling bit has already sunk 2,200 meters into the earth, and the well encased by a string of steel tubing. [N. Mushailov, VYSHKA general correspondent] [Excerpt] [Baku VYSHKA in Russian 18 Aug 84 p 1] 12659

MAINTENANCE BRIGADE EFFORTS CITED--Baku--They say about S. Shukyurov's NGDU [Oil and Gas Extraction Administration] Ordzhonikidzenef't' maintenance brigade, that each of their minutes is worth its weight in "black gold". The collective has overhauled 135 wells since the beginning of the year, completing their assignment for ten months ahead of schedule. Over 90 percent of the wells have been turned over to the field personnel ahead of schedule. The tone at work is set by the shift team operators, Deputies of the AzSSR Supreme Soviet Vida-di Guliev and Imamkhan Kyazimov. [By N. Nadzhafov] [Text] [Moscow SOTSIAL-ISTICHISKAYA INDUSTRIYA in Russian 24 Aug 84 p 1] 12659

NORTHERN BALKUN REFINERY OPERABLE--Ashkhabad--A comprehensive gas refinery has been put into operation at the Severnyy Balkun field in Eastern Turkmenistan. From here, 3 billion cubic meters of gas will be put into the Central Asia-Center gas main per year. [Text] [Moscow SEL'SKAYA ZHIZN' in Russian 15 Aug 84 p 1] 12659

NEW TUBING FOR TYUMEN--Tubing with new threaded connections, manufactured by the Tagangorsk Metallurgical Plant, is destined for the Tyumen oil fields. At the request of the Glavtyumenneftegaz Var'yegan Drilling Operations Administration oil workers, the important order was filled a half-year ahead of the deadline. The Taganrog workers have had a collaboration agreement with the oil workers for seven years. [Text] [Moscow EKONOMICHESKAYA GAZETA in Russian No 32, Aug 84 p 3] 12659

TARSDALLYAR FIELD BEGINS OPERATION--A new oil field has been put on the Azerbaijan geological map. A well, drilled in the Tarsdallyar area of the Kurin Steppe, has produced oil. [Text] [Moscow EKONOMICHESKAYA GAZETA in Russian No 33, Aug 84 p 3] 12659

USINSK RECOVERS MILLIONTH TON--USINSK, Komi ASSR--An Usinskneft' Administration collective has recovered the millionth ton of oil since the field was put into operation. As much of the valuable raw material has been recovered here plus some, than has been recovered during the last 10 years. The mineral is developed here as it is in the industries: a gas refinery is in operation to treat the petroleum associated gas. Usinsk has become the base for developing new fields in the Arctic. There is an industry organized and in operation here for the recovery of heavy, high-viscosity oil by thermal methods. Following the example of the Usinsk oil workers, all the Komineft' Association subdivisions are recovering fuel ahead of established deadlines. Since the beginning of the year, more than 4 thousand tons of valuable raw materials have been sent over the plan to the center of the country. [Text] [Moscow SEL'SKAYA ZHIZN' in Russian 7 Aug 84 p 1] 12659

ABOVE-PLAN RECOVERY IN UDMURTIYA--Igra Settlement, Udmurtskaya ASSR--More than 10 thousand tons of above-plan oil have been recovered by the Igra Oil- and Gas-Extraction Administration collective in Udmurtia. This young branch of the autonomous republic's industry is developing with increasing rapidity in the face of difficulties for the oil workers: the geological structure is challenging and the deposits are scattered widely. The combined competition of drilling rig erectors, drilling personnel and development and well-repair operators was a great help. The motto of these brigades, working on the principal of thoroughness, was "We build ahead of schedule, and we make the field operable ahead of schedule". The production workers are successfully coping with the next plan for this year. They have decided to fulfill increased socialist obligations in September, by Oil-Worker's Day. [By A. Sabirov, personal IZVESTIYA correspondent] [Text] [Moscow IZVESTIYA in Russian 29 Jul 84 p 1] 12659

ARLANNEFT' KNOW-HOW PAYS OFF--Ufa--Production workers of the Arlanneft' Admin-work smoothly: since the beginning of the five-year plan they have recovered over 200 thousand tons of fuel over their quota. What brought about this success? The drillers who, since the beginning of the five-year plan, have turned over 38 wells above the plan, stood out. But the most important factor was the production workers who skillfully utilized the producing well stock and repaired equipment promptly. According to the proportion of labor expenditures, the operational coefficient and the inter-service period for operating capacities, the Arlan workers achieved the best indicators in the Bashneft' Association. In addition, they carry out over a thousand geological and technical measures here which make possible the additional recovery of up to a million tons of oil. [By I. Payvin, SOTSIALISTICHESKAYA INDUSTRIYA personal correspondent] [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 5 Aug 84 p 1] 12659

YUZHКУЗБАССУГОЛ' MINERS EXCEEDING QUOTAS--Novokuznetsk--Eminent Kuznetsk Basin mining engineer and Hero of Socialist Labor V. Bardyshev's brigade is working smoothly and steadily this year from the Yuzhkuzbassugol' [Southern Kuznetsk Basin Coal] Association's Novokuznetskaya mine. The brigade's above-plan count since the beginning of the year has exceeded 40 thousand tons and is still growing: 2,500-2,700 tons of coal, of which several hundreds of tons are in addition to the program. Bardyshev's brigade has decided to fulfill the five-year plan by the anniversary of the birth of the Stakhanovite Move-

ment. They will recover 2,864 thousand tons of coal, 165 thousand tons above the plan, by this famous date. This means that labor productivity will increase by 9.7 percent relative to the plan, and because of lowered coal production costs 75 thousand rubles will be obtained. In July this leading collective will be working in a new longwall. During this month the miners have decided to recover 70 thousand tons of fuel. And for now, they are outstripping their own accelerated schedule. [By N. Poluyanov] [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 27 Jul 84 p 1] 12659

TRANSPORTABLE DAMS SAVE TIME--Shevchanko--Improving the technology used in developing oil-producing regions is helping the production workers of the Caspian Buzachi Peninsula to constantly increase recovery levels of valuable mineral resources. The one-hundred-thousandth ton of above-plan oil since the beginning of the year, has been recovered. Not every well which is sunk in an explored area will produce a commercial flow of oil--such are the special features of the occurrence of the peninsula's formations. This is why it would be inadvisable to lay a permanent pipeline, each kilometer of which costs thousands of rubles, to a facility in advance of its construction. It used to be this way: a well is steadily producing oil, but there's no way to transport it; you have to wait until the construction workers get the pipeline laid to the well. Innovators helped to solve this problem. They helped devise transportable oil-collecting systems, i.e., coffer dams. Now, only a few hours in all are required to connect a new well to a permanent, operating oil-field pipeline. The time saved preparing wells for operation has allowed production workers to recover almost one-third of the above-plan oil. [Text] [Baku VYSHKA in Russian 15 Aug 84 p 1] 12659

KALAMADDIN FIELD RECOVERY PROGRESSING--Ali-Bayramly--An oil flow has started up from the fourth horizon of the pay zone in the Kalamaddin field. Ali-Bayramly UBR [Drilling Operations Administration] foreman Guseynaga Akhundov's drilling crew, of all the crews working, put new development well No 86 into operation ahead of schedule. The well produces 40 tons of pipeline oil per day. There are still three wells in some degree of completion in the field. However the brigade of oil- and gas-recovery workers, led by Sadagyat Azizov, Shirvanneft' NGDU [Oil and Gas Extraction Administration] foreman, works especially thoroughly with their stock of operating wells and tries to observe a precise operating schedule with them. Together with maintenance personnel, they carry out effective geological and technical measures, and obligations for a daily above-plan increase in oil recovery are met. Additional reperformances in wells No 3 and No 65 have produced a generous oil flow. Additional recovery amounting to 10 tons per day was also obtained after identical measures were performed on well No 70. [By S. Garayev] [Text] [Baku VYSHKA in Russian 7 Sep 84 p 1] 12659

CASPIAN SLANT-HOLE WELLS PRODUCING--Yesterday, from well No 106, drilled from the first Caspian stationary platform, set up at a depth of over 100 meters, a flow of oil started up. The well produces 460 tons of oil per day. The drilling crew of foremen M. Aliyev and G. Isayev, of the Bukhta Il'icha MURB [Offshore Exploratory Drilling Administration] have successfully completed a well by construction after 4 months, instead of the planned 6. And the commercial speed of penetration was raised to record levels by the brigade--828



per drilling rig in a month. Let us emphasize, that this well was the eighth in succession, and was drilled from a special-purpose deep-water platform in less than two years. A few days earlier, well No 107 went into operation with a daily yield of about 400 tons of oil. Both were slant-hole wells, and MURB drill-crew members, engineers and geologists had to exert great effort to insure that the new holes were drilled precisely between operating wells. The leading drill crews have dedicated their success to the upcoming professional holiday: Oil and Gas Industry Workers' Day. Right now on the steel island preparations are going on to begin drilling of two more wells, vertical wells No 104 and No 108, which will have a projected deviation of 700 meters. The drill crews are set on getting these wells into production ahead of schedule also. [By O. Nechipurenko] [Excerpts] [Baku VYSHKA in Russian 22 Aug 84 p 1] 12659

COMPUTER AIDS PETROLEUM RESEARCH--Petroleum deposits located thousands of kilometers from the capital of Latvia are investigated "in absentia" in the Riga Polytechnical Institute imeni A. Ya. Pel'she. Additional information about the shape of petroleum formations, the spread of their temperatures and the properties of the surrounding soil is obtained with the help of mathematical experiments conducted in an electrical analog laboratory. The data, handed over to geologists, allows a reduction in the volume of exploratory wells drilled, and a recommendation for the most effective methods of developing new fields. Each experiment in simulating oil deposits has required complicated calculations. If general-purpose computers were used, these calculations would take at least 2-3 months. This way, results are arrived at after only a few hours. The multiprocess system, designed by VUZ scientists, makes such potentiality possible. In this system, a multipurpose digital EVM [computer] is combined with an analog computer.

The first analyzes the set problem and selects alternative solutions, and the second enters its corrections. Both parts of the combination uninterruptedly exchange information. Communication between them is completely automated. This electronic hybrid is characterized by its extraordinary speed and the precision of its computations. This more improved system is built on integrated circuits. Specialists believe that it can be used widely in various branches of modern science and technology. [Text] [Tallinn SOVETSKAYA ESTONIYA in Russian 20 Jul 84 p.2] 12659

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## COAL

UDC 553.96 (477)

### L'VOV-VOLYN COAL BASIN RESERVES INCREASED

Kiev GEOLOGICHESKIY ZHURNAL in Russian No 4, 1984 (signed to press 4 Jul 84)  
pp 29-33

[Article by M. A. Samarin, A. I. Galaka and V. I. Popovichenko; "New Data on the Commercial Coal Content of the Coal Fields of the L'vov-Volyn Basin"]

[Text] The L'vov-Volyn Basin is located on the southwestern slope of the Volyno-Podol'skaya Uplands, in the upper reaches of the Zapadnyy Bug River, within Volyn and Lvov oblasts in the USSR. Structurally, the basin is located on the southwestern edge of the West European Platform. It correlates with the Lvov Paleozoic Depression, which is complicated by brachyanticline folds striking northwest. These folds alternate with gently sloping synclinal structures which are linked with coal deposits. The extent of the basin is about 10,000 square km.

Upper Proterozoic (Riphean and Vendian), Paleozoic (Cambrian, Ordovician, Silurian, Devonian and Carboniferous), Mezozoic (Jurassic and Cretaceous) and Cenozoic (Neogene and Quarternary) deposits comprise the basin's structure. The coal formations are of commercial significance. The total thickness of the sediment mantle ranges from 2.5-3 km at the margin to 6-6.5 km in the center of the basin.

The Lvov-Volyn Coal Basin is important to the national economy due to its advantageous economic and geographic position, and also due to its excellent coal quality. On 1 January 1982, there were 21 operating mines in the basin with a total production capacity of 16.73 million tons per year. This included 11 coking coal mines with total capacity of 6.55 million tons per year.

The basin's coals are used as a premium power-generating fuel mainly in the UkSSR, the RSFSR, the BSSR and the Baltic Republics. A significant portion of these coals is used in the western oblasts of the UkSSR (at the Burshtynskaya and Dobrotvorskaya GRES's, as well as other generating stations). Construction of the 10.6-million-tons-per-year Central Enrichment has been completed.

However, the growth of coal production in the basin, and possibly even the maintenance of present production, is hindered by the fact that the operating mines have reserves mainly in the range of 1 to 20 years (5 mines have reserves of up to 4 years, 4 have reserves of from 5 to 9 years, 8 have reserves of from

10 to 19 years, while only 4 have reserves of over 20 years). There are two reserve sections where new mines can be built: the Paromovskiy No 1 in the Volyn Field and the Chernovgradskiy No 3 in the Zabugskoye Field. These sections have a total production capacity of 3 million tons per year (0.9 and 2.1 million tons, respectively). The total A+B+C<sub>1</sub> reserves of these two sections are 146.5 million tons (41.2 and 105.3 million tons, respectively).

The fields of the Lower-Carboniferous Visean and Namurian stages and of the Middle-Carboniferous Bashkirian Stage are of commercial significance.

In accordance with the MSK [expansion unknown] Plenum's decision (November, 1974) to make changes in the Carboniferous stratigraphic scale used in the USSR, the Serpukhovian Stage was made a separate part of the Carboniferous. This stage in the L'vov-Volyn Basin contains the Poritsskaya and Ivanicheskaya formations, which were previously a part of the Upper Visean Stage. The Serpukhovian Stage also contains the Lishnyanskaya and Buzhanskaya formations, which were previously a part of the Namurian Stage.

Since production organizations have continued to use the old designations for the Carboniferous in the L'vov-Volyn Basin to index coal seams and limestone marker levels, and since researchers disagree about the volume of the Serpukhovian Stage and the location of its boundaries, this article uses the old (pre-1974) geologic structure designations.

The commercial coal content of the basin is correlated with the best-studied fields of the Namurian and Bashkirian stages (by the new designations, the Serpukhovian and Bashkirian stages). These stages extend over 1,000 square km.

The basin's basic industrial seams are the  $n_7^1$ ,  $n_7^v$ ,  $n_8^v$  and  $n_9$ .

According to the pre-1960 requirements (minimum workable seam thickness, 0.6 meters, and A<sup>c</sup> up to 40 percent), the proven reserves in the basin were about 1.5 billion tons. After new requirements were introduced (minimum seam thickness, 0.7 meters, and A<sup>c</sup> up to 30 percent), these reserves were reduced to almost half of the previous reserves. Thus, as of 1 January 1979, the basin's A+B+C<sub>1</sub> reserves totaled 761.8 million tons, including 415.9 million tons (60 percent of all reserves) for operating enterprises and enterprises under construction, 41.2 million tons (6.1 percent) for reserve sections, 131.5 million tons (19 percent) for exploration areas, 98.5 million tons (14.3 percent) for promising sections and 3.3 million tons (0.5 percent) for other sections.

The basin is divided into the Volynskiy Coal Region (the Volynskoye Field), the Chernovgradskiy Coal Region (the Mezhhrechenskoye, Zabugskoye and Sokal'skoye fields) and the Yugo-Zapadnyy Coal Region (the Tyaglovskoye Field and the Lyubel'skaya Exploration Area, which contains the Karovskaya Structure) (see Fig 1). The first three of the above fields are being put into commercial production. The basin's coals are long-flame, gassy and medium-volatile.

In order to study the Visean fields of the L'vov-Volyn Basin and to single out promising new areas for coal exploration, PGO [possibly Department for the Prediction of Geological Reserves] Sevukrgeologiya

(the former Kiyevgeologiya Trust) of the UkSSR Ministry of Geology made a map predicting the coal content of the basin's Visean fields.\* After processing and analyzing the geological and geophysical data, they determined that the central and southwestern parts of the basin were the most promising areas to find new commercial coal seams of the Visean and Namurian stages. Coal exploration work was begun in 1970 by the L'vov Expedition of PGO Sevukrgeologiya, taking into account these recommendations, in these areas of the basin. This work was completed in 1981. This exploratory work confirmed the authors' conclusions on the extent of commercial coal fields of the Visean, Namurian and Bashkirian stages to the south and southwest of previously discovered fields.

The Visean deposits extend over about 10,000 square km and are more extensive than the deposits of other Carboniferous stages. However, their coal content was studied in detail only in the eastern part of the basin before 1970. In that area, they occur at depths of 220-350 meters. The Bubnovskoye and Busskoye fields in this region were explored. These fields contained one low-grade coal seam 0.5 to 0.55 meters thick. In the central and southwest parts of the basin, the Visean deposits are at depths of over 400 meters, and before 1970 had practically not been studied at all.

As was noted above, exploratory work was done in this part of the basin, beginning in 1970, by PGO Sevukrgeologiya (on areas adjacent to explored fields) and by Ukruglegeologiya Production Association of the UkSSR Ministry of the Coal Industry (on the fields of operating mines and mines under construction). In all, over 300 exploratory holes were drilled (about 30,000 total meters) in the L'vov-Volyn Basin. The holes were located along lines perpendicular to the strike of the coal deposits. The distance between the lines was 2-4 km; the wells were 2 km apart. In certain cases, they were somewhat more closely spaced.

The exploration work showed that the Visean deposits lie transgressively on the eroded surface of the Tournesian Stage or the Upper Devonian and are overlain by conformable sediments of the Namurian Stage. They are mainly dark-gray argillites, aleurolites and sandstones interlayered with limestones. In the lower part of the sequence, the limestone content reaches 50 percent and more.

Thirty-three coal interlayers and seams occur in the over-700-meter-thick Visean Stage. Nine of these ( $v_0^3 \cdot v_0^4 \cdot v_2^3 \cdot v_4^2 \cdot v_4^3 \cdot v_5^3 \cdot v_5^4 \cdot v_5^6$  and  $v_6$ ) are of commercial thickness (0.6 meters or more). Seam  $v_6$ , which is at the base of the Visean, is of commercial interest. It lies 8-25 meters lower than the base of the  $N_1$  Namurian limestone and is of commercial thickness in certain areas. Its commercial significance was established in the Mezhrchenskoye Field and in the Mezhrch'ye-Zapadnyy Section. The southwest part of the basin is also a promising area; a number of drill holes in that area have shown the seam to be of commercial significance.

\*A. I. Galaka, M. A. Samarin, A. A. Sakharov and L. Ya Solovova, "New Data on the Coal Content of the Visean Fields of the L'vov-Volyn Basin," GEOL. ZHUR., vol 32, is 1, pp 118-120, 1972.

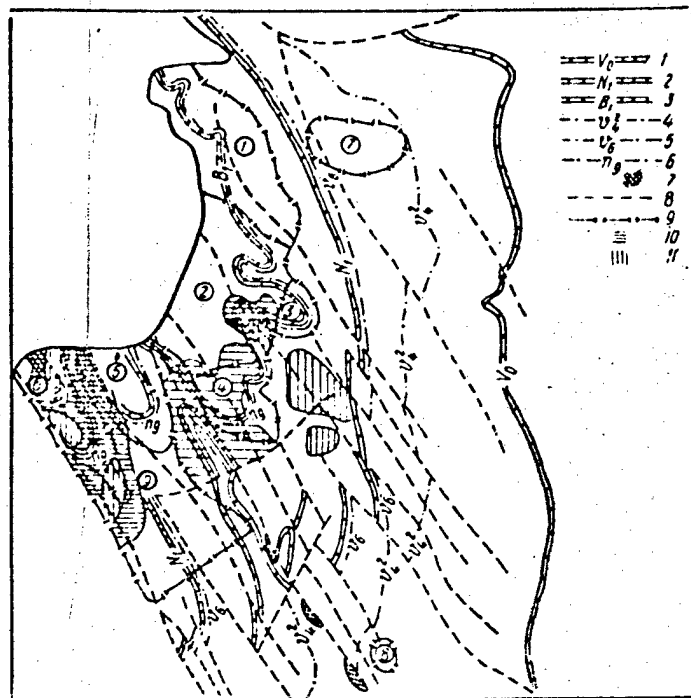


Figure 1. Schematic Map of the L'vov-Volyn Coal Basin

Limestone bed exposure on the Paleozoic surface:

1)  $V_0$ ; 2)  $N_1$ ; 3)  $B_1$ ;

Coal seam exposure on the Paleozoic surface:

4)  $v_4^2$ ; 5)  $v_6$ ; 6)  $n_9$ ;

7) Devonian exposures on the Paleozoic surface;

8) tectonic disturbance;

9) boundaries of coal fields and exploration areas;

10) area with predicted  $P_1$  reserves;

11) same, with  $P_2$ ;

Coal fields and exploration areas (circled numbers):

1) Volynskoye

6) Karovskoye

2) Zabužskoye

7) Bubnovskiy Section

3) Sokal'skoye

8) Busskoye

4) Mezhrchenskoye

9) Lyubel'skaya Exploration Area

5) Tyaglovskoye

The working thickness of the  $v_6$  seam varies from 0.6 to 1.65 meters. Its depth varies from 315.7 meters in the northeast to 1380.8 meters in the southwest. It has a simple structure in the southwest part of the basin and a two-bench

structure in the Mezhrach'ye-Zapadnyy Section. The thickness of the rock parting between the two benches does not exceed 0.2 meters.

Table 1. Coal Quality of the  $v_6$  Seam

Characteristic	Content		Average
	From	To	
Analytical moisture content, %	0.3	3.7	1.3
Ash content, %	4.6	30.4	13.9
Volatile content, %	20.3	46.1	34.7
Total sulfure, %	0.6	5.96	1.50
Heat of combustion, kcal/kg	8180	9159	8652
Density, g/cm <sup>3</sup>	1.41	1.48	1.44
Thickness of plastic layer, mm	13-14	25	22
Carbon content, %	81.3	89.0	85
Hydrogen content, %	4.8	5.7	5.2

The Visean coal seams consist of clarain-durain coal. As the seam depth increases and the coal-bearing deposits become thicker, the intensity of metamorphism of these coals increases (as do the coals of the Namurian and Bashkirian stages) from the northeast to the southwest from grade  $G_6$  to grade Zh and even to grade K (see Table 1).

Along with evaluating the coal content of the Visean deposits, the working coal content of the Bashkirian and Namurian deposits adjacent to explored fields was determined. In the southwest part of the basin, drill holes found eight workable coal seams: three in Bashkirian and five in Namurian deposits. In the central part of the basin (to the west, south and east of the Mezhrachenskoye Field), the  $n_0^6$  seam was found to be of workable thickness (over 0.6 meters).

In 1978-1979, PCO Sevukrgeologiya recalculated the estimated reserves of promising areas, including the L'vov-Volyn Basin.\*\* The recalculation took into account exploration data as of 1 July 1979. The calculated acceptable-grade estimated reserves, confirmed by the Inter-Organizational Expert Commission (July 1979, Moscow), for the L'vov-Volyn Basin totaled 473 million tons (Table 2).\*\*\* The exploratory work done during 1978-1981 in the Lyubel'skaya Area confirmed (and even significantly increased) these estimated reserves. Thus, as of 1 January 1982, the  $C_2$  reserves of this area totaled 428 million tons. The exploration area (the  $v_6$  seam) in the mining field of the Zabugskoye and Mezhrachenskoye fields, as well as an area partially adjoining the latter, were explored in 1979-1980. This area increased the balance reserves of  $G_6$ ,  $G_{12}$  and

\*\* According to a decision of the Permanent CEMA Commission on Geology (1976), estimated coal reserves in promising areas of all CEMA countries were recalculated.  
 \*\*\* Estimated reserves include coal seams over 0.6 m with AC up to 40 percent. Category  $P_1$  estimated reserves refer to coal reserves of explored areas, while category  $P_2$  reserves refer to little-explored areas.

Zh grade coals by 77.5 million tons in category  $C_1$ , and by 50.3 million tons in category  $C_2$ . As a result, the L'vov-Volyn Basin coal reserves as of 1 January 1981 were increased in category  $A+B+C_1$  to 806.1 million tons and in category  $C_2$  by 50.3 million tons.

Table 2. Acceptable-Grade Estimated Reserves of the L'vov-Volyn Basin

Region, Area	Seams containing the estimated reserves	$P_1$	$P_2$	$P_1+P_2$
Chernovgradskiy Region				
Mezhrech'ye-Vostochnyy	$v_6, n_0^6, v_0^4, v_4^3$	--	43	43
Zabugskoye Field	$v_6$	11	--	11
Mezhrechenskoye Field	$v_6$	52	--	52
Yugo-Zapadnyy Coal Region				
Lyubel'skaya Exploration Area	$v_6, n_7^1, n_7^v, n_8^v, n_8^v,$ $n_9, b_1(n_{10}), b_3(n_{12}),$ $b_4(b_1)$	265	18	283
Mezhrech'ye-Zapadnyy Section	$v_6$	84	--	84

In conclusion we note that this scientific and exploration work has for the first time established the commercial coal content of the Visean Stage deposits of the L'vov-Volyn Basin. They have expanded the boundaries of the coal content of the Namurian and Bashkirian stages and have located promising new areas. The significant estimated reserves of high-grade coals (G, Zh and some K) were confirmed by exploration. This has greatly improved the prospects for the growth of coal production in the L'vov-Volyn Basin.

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12595

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## COAL

### NEW APPROACH TO UNDERGROUND MACHINERY REPAIR PROPOSED

Kiev RABOCHAYA GAZETA in Russian 8 Sep 84 p 2

[Text] The article "Achieved by Cooperation," published in our newspaper on 17 July 1984, told of an agreement between the entry drivers of the brigade headed by Hero of Socialist Labor N. G. Oleynikov from the Fourth Administration of Dneproshakhtostroy Combine and fitter-assemblers of the Rutchenkovskiy Mine Repair Plant, who are headed by N. N. Khoroshunov.

The essence of this new form of cooperation between two workers' collectives is that the mine developers have promised to double the normative service life of the 4PP-2 entry-driving machine after capital repairs. For their part, the repair workers have promised to make repairs without sending the machines up to the surface. This method of using and maintaining mining equipment greatly raises output and guarantees an accelerated pace of new mine development.

The Collegium of UkSSr Minugleprom [Ministry of the Coal Industry] approved this initiative. The ministry organized a meeting of specialists which was attended by a RABOCHAYA GAZETA correspondent. Organizational, structural and economic problems were discussed at the meeting, as were means for widely disseminating the experience of the innovators. We publish below the opinions of several meeting participants.

#### An Exchange Fund is Needed

[Article by I. Mitko, deputy chief of the Power-Mechanics Administration of UkSSR Minugleprom]

The problem of increasing the service life of coal-face equipment is one of the most critical problems in the sector. After all, all modern machines, either cutter loaders or entry-driving machines, are very complicated and expensive. The value of the initiative of the entry-drivers of N. G.



Oleynikov and the repair workers of N. N. Khoroshunov is that it opens a realistic path to improving mining machinery operating efficiency. The longer the machinery stays at the coal face without having to be sent up to the surface, the more coal will be mined and the more development work will be completed.

However, in order to organize equipment repair underground by repair experts, an irreducible exchange fund must first be created at mining-repair enterprises. In order to do this, reliable assemblies must be removed from irreparable mining machines as a first step. The assemblies must then be repaired, tested and completely readied for customer shipment. Then, as requests come from the mines, the parts are delivered to the coal face to replace the broken parts. But even with such a backup supply, additional spare parts, such as gear sets, bearings and etc., will be needed. And it is just these spare parts that the Yasinovatskiy Machine Building Plant, which builds the entry-driving machines, is clearly unable to supply in sufficient quantity.

Therefore, there's only one solution: the active participation of machine builders and mining machine designers in underground unit repair.

#### The Manufacturer's Responsibility

[Article by N. Podgorodetskiy, chief engineer of Donetskugleremont Production Association]

The businesslike cooperation between the entry drivers of Dneproshakhtostroy Combine and the fitter-assemblers of the Rutchenkovski Mining Repair Plant is interesting. However, considering the fact that the sector's normative demand for spare parts is only 60 percent fulfilled, it would hardly be possible to implement this initiative for all mining equipment in use.

Therefore, it would be more effective to organize equipment assembly repair underground for mine development workers, support the initiative and gain experience in order to transfer it to operating mines. At the same time, the mine development workers must operate the machinery properly and present it for maintenance on time, rather than running it until it falls apart. In particular, studies of 4PP-2 machines at that same Dneproshakhtostroy, at mines Nos 16-17 and 21-22, showed that some assemblies on these machines had been used until they were irreparable.

And there's more. Many plants of USSR Mintyazhmash [Ministry of Heavy Machine Building], such as NKMZ [Novokramatorskiy Machine Building Plant], Uralmash, Zhdanovtyazhmash and others, provide technical inspection of their machinery's performance during the guaranteed service life. If necessary, they fix any maladjustments or breakdowns themselves. The Yasinovatskiy Machine Building Plant of the same department, though, has a different practice: after they deliver a machine to a customer, they don't care about anything at all.

Cooperation between operating personnel and repair workers is important and profitable. However, mining equipment manufacturers must also be included. Great gains would be made by joining the links between the machine building plant, the repair plant and the mine.

#### Increase The Resource

[Article by A. Tarasov, chief mechanic of Ukrshakhtostroy Association]

The organizations of Dneproshakhtostroy Combine presently operate eleven 4PP-2 entry-driving machines. Five of them have completed their normative service period and are awaiting capital repair. How "hard" did these machines work? In Administration No 3, three entry-driving machines excavated from 71,000 to 91,000 tons of rock during their service period, compared to the norm of 63,000 tons. The 4PP-2 machine carrying serial No 377, operated by Administration No 4, excavated 120,947 tons of rock.

On the one hand, these facts testify to the reliability of the equipment produced by Yasinovatskiy Machine Building Plant. On the other hand, they show the care given to the equipment by the entry-driving collectives.

But, no matter how large a strength safety factor is designed into a machine and no matter how well a machine is maintained, there comes a time when a machine must be sent away for repairs.

This is always a sad moment for mine development workers. Experience has shown that it takes almost six months to disassemble the machine, complete the capital repairs and reassemble it in the mine. A solution is suggested by the initiative of the entry-driving brigade of Hero of Socialist Labor N. G. Oleynikov and the fitter-assembler brigade of N. N. Khoroshunov. These collectives conducted an experiment in the unit repair of a 4PP-2 machine right at the working face. It showed that not only time and a lot of money could be saved, but also the machine's service life could be extended.

The machine operated by the entry-driving brigade of P. D. Dyadechno, of Mine Development Administration No 3, Dneproshakhtostroy Combine, is now being repaired in the same manner.

However, as RABOCHAYA GAZETA noted, the growth of this initiative is being hindered by the lack of incentive on the part of the factory fitters who guarantee the continuous operation of the machine in the mine. In addition, underground repair is not even included in the factory's plan!

It would seem that these problems should be solved by the respective administrations of Minugleprom.

Thus, in the opinion of the specialists, the initiative of the brigades of N. G. Oleynikov and N. N. Khoroshunov is opening the way to the increasingly effective use of both entry-driving and cutter-loader equipment. The initiative will also increase

equipment service life, save lots of time and reduce expenses.

However, the broad implementation of underground unit repair requires the efforts of not only operating and mine-repair personnel, but also of the manufacturers. It would seem that the Yasinovatskiy Machine Building Plant is long overdue in adopting the experience of NKMZ, Uralmash and Zhdanovtyazhmash in the area of technical maintenance of the equipment they produce. Obviously, Minugleprom's machine building plants must also respond to the idea of these innovators.

12595

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## COAL

### LATEST DEVELOPMENTS IN PLOW TECHNOLOGY REVIEWED

Kiev RABOCHAYA GAZETA in Russian 24 Aug 84 p 1

[Article by M. Lobasov, director of the Voroshilovgrad Branch of ShakhtNIUI [Shakhtinsk Coal Scientific-Research and Project-Design Institute] imeni Terpigorev, candidate of technical sciences: "The Plow Is The Miner's Friend"]

[Text] An important event has occurred in the republic's coal industry, although the event remains somewhat obscure. After a long period of decline, coal production by plow devices and machines has begun to rise at a fairly fast rate.

Our collective has been involved in developing plow technology for over 30 years. The first-generation plows have seen much use in Donbass mines. These plows helped to set all-union and world coal production records: over a million tons of coal were mined from one face by the brigade of A. Tatsenko at the Imeni 50 Letiya Sovetskoy Ukrainy of Donbassantratsit Combine and by the brigade of M. Chikha from Rostov Oblast.

But time passes, and the number of thick seams in the Donbass decreases year after year. As a result, more thin and very thin seams have to be worked--seams that had been considered unworkable, with non-balance reserves. Narrow-width cutter-loaders have to "pass up" such seams. Plows are just about the only technology that can remove the coal.

For this purpose, our collective developed the UST-2M unit (manufactured by the Shakhtinskiy Machine Building Plant) for mining seams from 0.55 to 1.0 meter thick. This plow was put into series production in 1981 and received the State Mark of Quality. UST-2M machines are now operating at 63 coal faces in the Donbass. At Voroshilovgrad Oblast mines alone, second-generation plow systems and machines produced 15.4 million tons of high-grade coal in three years. Experience indicates that under similar mining and geological conditions, plows increase labor productivity by 25-50 percent and reduce production costs by 15 percent compared to cutter-loaders. Plows increase the yield of large- and medium-sized coal up to 70% and reduce the coal dust content in the fuel down to 25 percent. On faces worked by cutter-loaders, the coal dust content can reach almost half, which sharply reduces coal production efficiency. This involves not

hundreds or thousands, but millions of rubles of savings. Plows produce less dust than cutter-loaders, improving the working conditions and making mines safer. Therefore, a saying arose among miners: "The plow is the miner's friend."

The development and implementation of automated coal production systems is now on the agenda. These systems would not require the constant presence of personnel at the coal faces. Our collective has taken on this task in earnest. The miners correctly call the new KSA plow system "third generation technology" and "the machine of tomorrow." The branch's collective is now working on this system.

The design work is basically finished. Drawings for the prototype have been sent to the manufacturing plants. The first unit is to be provided to miners for testing in December of next year. The collective of the Imeni 23 S"yezd KPSS Mine (Roven'kiantratsit Production Association) is preparing at top speed for this important process. A new level is being opened up. Entries and coal faces are being excavated that will meet the requirements of the world's first automated coal mining system.

The implementation of the latest machinery in the coming years should help solve the task facing the scientists and production workers: raise plow coal production from 15 to 35 million tons per year.

12595

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## COAL

### FLUIDIZED BED TECHNOLOGY IMPROVES DONETSK AIR QUALITY

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 13 Sep 84 p 2

[Article by A. Didur, Donetsk: "The Sky Clears Up In Donetsk"]

[Text] The residents of mining capital Donetsk have recently begun to notice some delightful changes: the smokestacks of the boiler rooms which supply heat and hot water to homes and industrial enterprises now put out much less smoke. Who has taken the color out of the smoke plumes above the city?

The organization that has taken the initiative to modernize the boilers is the Teploenergoavtomatika Specialized Administration of Donetskguleavtomatika Trust, UkSSR Minugleprom [Ministry of the Coal Industry]. Its personnel have taken on the reconstruction of combustion chamber devices with great determination. They have shown in practice that smoke emissions can be reduced and low-grade coals can be burned more efficiently. This is done by burning the coal in a fluidized bed. This is what the administration's director, Vladimir Vasil'yevich Gavrilenko--one of the designers of the project and a tireless propagandist for it--says:

"The coal industry is an extractive sector. At the same time, it also uses an enormous amount of energy resources: no mine or mining settlement could get by without heat and hot water. Within the system of the republic ministry alone, over 8 million tons of fuel were consumed for these needs. At the same time, the series-produced industrial boilers equipped with grate-fired furnaces were designed to operate on high-grade coals. In practice, the quality of incoming fuel has recently declined because of higher ash, moisture and small fractions contents. It is not surprising that its utilization factor barely reaches 50 percent. And, even one percent on a republic-wide scale is equal to 80,000 tons of coal. Thus, the implementation of the new technology is producing direct savings that are expressed in millions of tons of fuel."

The first attempt to burn low-grade fuel in a fluidized bed was made after the rebuilding of the furnace at the Imeni 24 S'yezd KPSS Mine of Pavlogradugol' Production Association. The results showed that with certain design and technology changes, the same boilers could operate much more efficiently. The fuel layer is now much thicker than in other furnaces. High-pressure fans supply enough air through the layer so that

the coal seems to boil. Each fuel particle receives enough oxygen to ensure complete combustion. At the same time, measures are taken to prevent the slag from caking.

Lately, one can see the administration's engineers and installation personnel at many of the oblast's mines. There, with their sleeves literally rolled up, they are helping to adjust the new combustion technology. They still visit the Mospinskaya Mine in Donetsk most often: it has become a kind of laboratory for the innovators.

When the "advance party" of workers from the administration, including engineers A. Tkach and M. Konstantinov and fitters V. Storozhuk, N. Tkachenko and V. Chernov, arrived here several years ago, they found an old combustion chamber. The stokers had to manually shovel tens of tons of coal a day into it. Incidentally, this coal came from other regions, since the unit could not burn local coal. The newly arrived brigade decided to build a separate thermal reactor for burning the coal in a low-temperature fluidized bed. The boilers themselves were to serve as heat utilizers.

The results were better than had been predicted: the local coal, which had not been used for a long time, was burned at a rate of 79-82 percent. And now, two boilers, instead of four, provide sufficient heat.

The boiler room of the Mospinskaya Mine is more often being called a thermal shop. And not without reason: it actually reminds one of a shop in a modern enterprise, where automation takes the place of people. The health and sanitary conditions of the workplace have significantly improved. The stokers now wear coats instead of dusty overalls.

The fairly thick stream of smoke which had previously emanated from the smokestack has been reduced to a barely noticeable wisp. The exhaust now is cooled in a cooling chamber, where particulates are trapped, before going into the atmosphere. It all adds up to this--more heat and less dust and smoke.

The energy workers of the Donbass are already thinking about the next stage. The fly ash that is now being dumped is a wonderful material for producing cement and slag blocks.

The Donetsk masters of small-scale energy are now thinking about a closed cycle. The cycle would be like this: 1) fuel-preparation shop-sections for boiler rooms using high-ash-content coal; 2) rebuilt industrial and residential boilers and 3) utilization of waste products for economic and other needs.

More and more smokestacks in Donetsk Oblast are now cutting back their long black plumes. And, the sky above the mining region is becoming brighter.

12595

CSO: 1822/30

## COAL

### BRIEFS

NIZHNEVARTOVSKNEFTEGAZ OIL PRODUCTION LAGS--Of the eight oil-and-gas producing administrations in Nizhnevartovskneftegaz Association (whose general director is F. Marychev), only two are meeting their plan: 'Belozerneft' and 'Pokachevneft'. The others are quite a bit below plan. 'Var'yeganneft' and 'Ur'yevneft' are each more than 600,000 tons below their planned production. The association's total oil production shortfall is over 1.3 million tons. Well-site engineering services are not sufficiently effective. Secondary recovery methods are not being used widely enough. Help from Minnefteprom [Ministry of the Petroleum Industry] is not producing the expected results, although the ministry recently began to supply additional funds, equipment, personnel and transport to develop the region. The oil workers are especially critical of their suppliers. Minkhimmash [Ministry of Chemical and Petroleum Machine Building] equipment suppliers such as the Borets Association in Moscow and a number of machine building plants in Baku are delivering low-quality, incomplete equipment to the Siberians. [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 18 Sep 84 p 3] 12595

VAKHRUSHEVUGOL' PRODUCTION, PRODUCTIVITY UP--Karpinsk--The miners of Vakhrushevugol' Association have produced over 100,00 tons of coal above plan since the first of the year, allowing them to revise their annual obligations. The association had an above-plan increase in labor productivity of two percent--twice as much as was originally targeted. Because of this, the volume of additional annual coal output will increase to 160,000 tons per year. Following the Stakhanovite tradition, the leading miners are generously sharing their experience. [Text] [By A. Mal'tsev] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 12 Sep 84 p 1] 12595

MINE PRODUCTION EXCEEDS PLAN--Roven'ki, Voroshilovgrad Oblast--Although tired after their shift, the miners had smiles on their faces. The working comrades were greeted with music and flowers. A banner proclaiming "1,000,000 Tons Produced" was raised high. This is how much coal the miners of the Imeni Kosmonavty Mine (Roven'kiantratsit Production Association) have produced since the beginning of the year. One hundred and forty thousand tons of that million are above-plan. This level was reached a month ahead of schedule. The basis of this success was the untiring struggle of the coal-mining experts for an above-plan increase in labor productivity. Productivity was especially high in the brigade of



Hero of Socialist Labor G. Motsak. The brigade daily produces 1,700 tons or more of anthracite, compared to the plan of 1,300 tons. All other mining brigades are overfulfilling their tasks. [Text] [By V. Mikhaylichenko] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 12 Sep 84 p 1] 12595

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## NON-NUCLEAR POWER

### KAMAZ POWER STATION CONSTRUCTION BEHIND SCHEDULE

Moscow STROITEL'NAYA GAZETA in Russian 4 Jul 84 p 1

[Text] The Kamaz plant's heat and power station (TETS) is by right referred to as its energy heart. However, the demand for heat increases with every year, and the time has come for expanding the station's capacity. That is why it was decided to begin construction of its second stage.

Of the projects slated for installation in the framework of the station's expansion several have been put onstream - four water-heating and one power boiler. Another - the 175 thousand kilowatt turbine No 10 - is to be commissioned in December of this year.

The experienced collective of the Metallurgstroy administration, Kamgesenergostroy construction trust, took up the assignment with enthusiasm. It undertook to complete the turbine job ahead of schedule, by Power Worker's Day. Construction and installation plans are being fulfilled every month.

Working here from the outset is R. Valyev's brigade. This year it contracted to lay the foundation for the turbine and install the columns of the main building's second stage, and every month does 140 percent or more of its plan.

And yet the fulfilment of the gross production plan and the shock work of a few collectives brings little joy to client and builders alike. Because clearly discernible behind the overall figures is a lagging behind on specific projects.

"We provided our main subcontractor, the Kama administration of the Volgoenergomontazh construction trust, with a workforce worth over 900 thousand rubles," says chief engineer of the general contractor construction and installation administration No. 42 A. Goremykin. "But there is a shortage of installation men. Together with auxiliary services there are now 150 of them, whereas the need is for twice that number."

Shortcomings in work organization were augmented by snags in supplies for the construction project. The steelwork plant of the

Kangesenergostroy construction trust did not deliver the 200 tons of metal structures for the turbine servicing areas and the 100 tons of overhead beams for the main building which were all supposed to have been shipped in as far back as March. Neither have we received any accumulator tank, and that is another 90 tons. Without the overlapping of the de-aerator section you cannot install anything positioned above it.

Work on the outstation facilities has not begun because of the absence of large-diameter water circulation conduits. Their delivery by the North Caucasus steel structures plant of the Energostal'konstruktsiya construction trust is slated only for the third quarter.

All these construction organizations and enterprises belong to one master - the USSR Ministry of Power and Electrification, which commissioned the project in the first place. Why, then, are these schedule violations allowed to happen? According to the Central Statistical Administration of the USSR, Soyuzenergomontazh, to whom the construction trusts Volgoenergomontazh and Sidromontazh are subordinated, has more workers than allowed by plan. Yet this underway project is suffering from a manpower shortage. What is this - an inability to get things organized or just plain irresponsibility?

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## NON-NUCLEAR POWER

### NEW PUMPED STORAGE PLANT UNDER CONSTRUCTION IN ZAGORSK

Frunze SOVETSKAYA KIRGIZIYA in Russian 3 Aug 84 p2

[Article by APN correspondent A. Perevoshchikov: "Building the Zagorsk GAES"]

[Text] The first Soviet industrial pumped storage power station (GAES), which has a capacity of 1.2 million kilowatts, is being erected near the Moscow region town of Zagorsk. An experimental station of this type is already functioning in Kiev. The Zagorsk GAES will become a testing range for future GAES projects in the European part of the country.

The Energy Program of the USSR, which runs to the year 2000, assigns a special role to GAES's. The fact of the matter is that most of the increment in the production of electricity in the European part of the country is to be provided by atomic power stations (AES). The optimal operating mode of the latter is a uniform workload throughout the day. However, the consumption of electricity in this region over a 24-hour period tends to fluctuate. It is precisely the GAES that allows this unevenness to be leveled out in the most efficient way. During peak hours the GAES functions as an ordinary hydroelectric power station, the sole difference being that the water is not dumped into the river, but accumulated in a so-called lower reservoir. At night the GAES, taking in the redundant electricity generated by one or more AES, pumps the water from the lower reservoir into the upper in preparation for a new cycle. As established by experts, total GAES capacity in the European part of the Soviet Union must comprise about 20 percent of the overall capacity of the atomic power stations in this region.

What are the parameters of the Zagorsk GAES?

The volume of the lower reservoir is 33 million cubic meters, the upper - 30 million. The difference in their water levels is 100 meters. Installed in the station will be 5 turbines of 200 thousand kilowatts each. The length of the pipeline bringing water to the

turbines will be 740 meters, the diameter of its cross section - 7.5 meters. All the station's equipment will be Soviet made.

"The selection of this spot in the plains part of the USSR is no accident," says construction project chief Vladimir Plotnikov. "We were influenced by two factors - the natural elevation differential and the possibility to make maximum use of local building materials (not far from the construction site is a sand and gravel quarry). Moreover, there is a railroad and highway close by, to hook up the GAES to the Moscow grid you have to put up only 60 kilometers of power lines.

The pipeline is being assembled from large-diameter steel-concrete segments which we make on the spot by adding a concrete facing to the traditional steel ring, thereby enhancing the reliability of the whole structure. The laying of the segments is done by a powerful winch that can operate at substantial elevation differentials and under any angle.

The building material we use for the Zagorsk GAES project is a so-called broken-stone concrete. Under the customary method of preparing the concrete mix all small particles it may contain are removed. We, on the other hand, utilize the small fragments of broken stone as a dispersing filler. This lends the concrete the required durability and frost resistance, which is especially important for the Zagorsk GAES reservoirs because the amplitude of the daily fluctuations in the water level will be 9 meters. In the winter these 9 meters of concrete surfaces will, therefore, be periodically exposed to low temperatures. The use of broken-stone concrete not only improves the frost-resistant properties of the structure, but reduces the cost of the project by several million rubles as well.

We are using a novel construction technique for the Zagorsk GAES. The "classical" work sequence is to bed the soil in several 40-centimeter-thick layers every one of which is rammed to maximum density. At the Zagorsk project we are laying 5-7 meters of soil in one move and compacting it over its entire depth with a 15-ton mechanism. This makes for a threefold increase in the pace of construction, and we save millions of cubic meters of soil because only its organic layer is stripped off.

Briefly about the machinery being put in. We are installing mechanisms that operate in both the turbine and the pump modes. This new top-quality hydrogenerator is sufficiently profitable. Moreover, its use will free us from any dependence on the vicissitudes of the foreign market.

The investment recovery time for the station is tentatively set at five years."

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## NON-NUCLEAR POWER

### AZERBAIJAN TO GET HIGH VOLTAGE OVERHEAD POWER LINE

Baku VYSHKA in Russian 4 Jul 84 p 1

[Text] The Azerbaijan state regional electric power station (GRES) is continuously increasing its electricity output. Each year the station's capacity expands by 300 thousand kilowatts. To transmit that electricity to the various industries of the national economy and ensure greater reliability in their electric power supply a new high-voltage overhead power line had to be built. The leading consumer of electricity in the republic is the Baku Industrial Complex, and this is where the line is heading for. Starting in Mingecheaur, it will cross the Shirvan valley along its northern edge, then run from west to east along the southern slopes of the main Caucasian Range through the territories of Yevlakh, Vartashen, Kutkashen, Agdash, Ismailly, Geokchay, Akhsu, Kyurdamir, Shemakha and Apsheron rayons. It goes without saying that the industrial enterprises, kolkhozes and sovkhoses located here will see a substantial improvement in their electricity supply.

Furthermore, the line will feed electricity to the United Transcaucasian System as well. All this highlights the importance of the new project for every sector of the national economy.

This is the first such high-voltage (500 kilovolts) power line to be erected in Azerbaijan. It vividly illustrates the growth of the republic's energy supplies and its increased contribution to the country's Energy Program.

The design project for the line was developed by the Azerbaijan affiliate of the "Energoset'proekt" institute, USSR Ministry of Power and Electrification (Minenergo). The general contractor is the "Kavkazelektroset'sroy" construction trust. The actual building of the line has been assigned to three of its mechanized columns - Nos 8, 23 and 54.

They began work in the second quarter. The transmission towers and pedestals are supplied by Minenergo enterprises. Over 100 of these have already arrived. 4.2 million rubles' worth of construction and installation work will be done before the year is out. In addition to the overhead power line a high-voltage distributor substation will be built on the Apsheron peninsula. The entire complex is due to be commissioned next year.

## NON-NUCLEAR POWER

### POTENTIAL RESERVES OF SMALL RIVERS FOR ENERGY SUPPLY DISCUSSED

Moscow PRAVDA in Russian 7 Jul 84 p 2

[Article by Corresponding Member of the USSR Academy of Sciences D. Zhimerin, chairman of the Scientific Council of the State Committee for Science and Technology, Corresponding Member of the USSR Academy of Sciences N. Kovalev, chairman of the Central Administration of the Scientific and Technical Society of Power Engineering and of the Electrotechnical Industry, and Candidate of Technical Sciences L. Mikhaylov, chief of the Gidroyekt Institute: "The Energy of Small Rivers"]

[Text] The search for additional energy resources, capable of replacing liquid fuel, has been under way during the past few years in all industrially developed countries. One of the directions is the feasibility of utilizing the potential energy reserves of small rivers on a new technical basis.

Let us stipulate immediately: "small" hydropower engineering cannot and should not replace "large" hydropower engineering in the combination that solves problems of power engineering, irrigation and transport. We are talking about the fact that the latest advances of scientific and technical progress permit a new look at its possibilities. The use of the energy of small rivers, of the drops of irrigation canals, of reservoirs of non-energy designation and also modernization of existing and renovation of small non-operating GES on the basis of new technology may become a significant contribution to the country's energy supply.

As is known, extensive construction of small GES with output of less than 5 megawatts was organized in the USSR during the postwar years. Special planning organizations and enterprises were created for this. Approximately 7,000 small GES with total output of 1.5 megawatts were constructed over a period of 5 years. Beginning in the 1950s, the development of large-scale power engineering and construction of electric networks, which provided rural regions with electric power, made small GES non-competitive. As a result, less than 400 of them remained in operation. At the same time, it was established by a check that, although many small GES are not operating, their main structures are still preserved and can be used.

A similar process of mass construction and later shutdown of small GES occurred in many countries, specifically, in the United States, France and Japan.

The search for progressive engineering solutions, directed toward increasing the economic effectiveness of small-scale hydropower engineering, is now being organized with regard to the rigid course toward reducing the consumption of petroleum for power engineering.

The "Basic Directions for Economic and Social Development of the USSR for 1981-1985 and for the Period up to 1990" provided more complete utilization of the energy of small rivers. To implement this, the USSR State Committee for Science and Technology formed a temporary scientific and technical commission. Having analyzed the situation, the commission presented a report to the scientific council of the GKNT [State Committee for Science and Technology].

For example, the commission preliminarily determined non-energy reservoirs with an energy potential on the order of 300 million kilowatt-hours annually in the RSFSR and the economic effectiveness of constructing small GES in regions of decentralized energy supply, where expensive diesel electric power plants are used, was also determined. The largest number of them goes to isolated regions of the north and east of the USSR (Kamchatka, Chukotka and Yakutiya) and the high-mountain regions of Central Asia and the Caucasus. The expenditures for delivery of fuel are high there and the cost of generated electric power reaches a ruble per kilowatt-hour. The consumption of diesel fuel by the electric power plants of these regions may increase to 5 million tons in the future. Under these conditions, small hydropower engineering will help to reduce the consumption of liquid fuel.

Worldwide practice shows that the main methods of increasing the economy of small hydropower engineering are conversion to the use of standard designs and standardized components in construction and use of complete sets of serial equipment. The task consists in the manufacturer delivering a hydroengineering unit that is ready for installation without assembly at the construction site. The control of the small GES should be automated so that its operation does not require maintenance personnel. These measures alone will permit a reduction of capital expenditures by almost one-third. Small GES can be erected by mobile specialized columns without temporary auxiliary structures. This method will provide an appreciable reduction of expenditures and will reduce the course of construction.

According to the recommendations of the scientific council of GKNT, the Hidroproyekt Institute of USSR Minenergo [USSR Ministry of Power and Electrification] will compile a technical and economic report on the basic directions for development of small hydropower engineering in the USSR and will evaluate the work on renovation of non-operating small GES, modernization of them and the volume of substantiated new construction in different regions of the country. Preliminary data indicate that more than 200 installed units of different types for small GES can be replaced by one or two types of hydroturbines. This standardization will appreciably increase the efficiency of operating small GES provided that a simple and reliable hydroengineering unit is developed.

To accelerate the beginning of operations, the Hidroproyekt Institute is investigating existing facilities and is also selecting those facilities which



can be erected on reservoirs and canals under construction and those planned for construction. We are talking, for example, about the Kursk Reservoir on the Tuskar' River and the Vladimir Reservoir on the Desna River, about the Konstantinovka and Bagayev hydroengineering complexes on the Nizhniy Don, about the Stavropol and Nevinnomyssk Canals and also about similar facilities in Central Asia, Kazakhstan and in the Far East, where it is feasible to construct small GES on the basis of standardized designs.

Success in this important matter will depend on organization of construction, manufacture and delivery of complete sets of equipment. It is now worth Minenergomash [Ministry of Power Machine Building] to organize development of standardized hydroturbine equipment in the near future for small GES and serial production of it at its own plants. According to preliminary calculations, it is planned to manufacture 170 modular hydroengineering units during the next few years for small hydropower engineering and then to manufacture up to 5,000 modular hydroengineering units for small GES. Brigades have already been created in a number of ministries to examine operating and shutdown small GES and development of their pilot group is under way.

Unfortunately, Minelektrotekhprom [Ministry of the Electrical Equipment Industry] and the department of electrical equipment industry of USSR Gosplan have not yet determined the volume of production of hydrogenerators for small GES for the 12th Five-Year Plan. USSR Minenergo should accelerate examination of operating and shutdown and small GES, while USSR Minsel'khos [Ministry of Agriculture] and the RSFSR Minrechflot [RSFSR Ministry of the River Fleet] should participate actively in this work. USSR Minenergo must also provide financing for the planned developments, without which construction of small GES cannot begin.

We feel that it is feasible to entrust construction to those organizations which develop dams, reservoirs and canals and entrust installation to the organizations which install hydroengineering and hydropower equipment there.

We note in conclusion that small GES, by slightly altering natural conditions, create favorable prerequisites for more complete utilization of the energy potential of a number of reservoirs. They will thus have an effect on fulfillment of the Energy Program, will provide conservation of fuel resources and will improve the electric supply of consumers located in the zone of their operation.

6521

CSO: 1822/14

## NON-NUCLEAR POWER

### GAS LINE CONSTRUCTION TO LADYZHIN GRES

Kiev PRAVDA UKRAINY in Russian 18 Jul 82 p 2

[Article by N. Baras', PRAVDA UKRAINY correspondent, Vinnitsy Oblast:  
"Rebirth of the GRES"]

[Text] The 25-kilometer branch of the gas line has now approached the main building of the Ladyzhin GRES. It will soon join the major gas pipeline Soyuz with the first three units of the power plant. The construction and installation organizations of Mingazprom [USSR Ministry of the Gas Industry] and Minenergo SSSR [USSR Ministry of Power and Electrification] planned to complete the main volume of work 1 month ahead of the planned deadline. Natural gas will flow to the burners of the plant's boilers in August.

Since startup of the GRES, the Ladoga power engineers have perhaps not had a more significant event than transfer of the station to natural gas. This is explained by two circumstances: by the importance of it for the country's economy and by the advantage for the enterprise.

"The calculations of our economists showed," says the chief engineer of the GRES Ye. K. Yakushin, "that the specific consumption of conventional fuel will be reduced by almost 8 percent with use of gas. Conservation of coal and fuel oil will be discernible--approximately 300,000 tons annually. The cost of a kilowatt-hour of electric power will be 1/1.5 as much. The conversion to gas will also have a positive effect on the region's ecology. In short, a considerable effect is anticipated."

But complicated and very intensive work still remains. The project envisioned laying a gas line, construction of a gas distribution station and two gas-distribution points and reconstruction of all six units of the GRES. Matters were complicated by the fact that reconstruction and the framework of the plant boilers had to be carried out without shutdown of production.

The real respiration of the power plant is felt just here--in the boiler and turbine shop, among the piles of fittings, pipelines and instruments. The shop has recently been transformed appreciably. Renovation is under way.

We found the brigade leader of installers of the Yuzhteploenergomontazh Trust P. A. Mulyavka in the fourth unit. Matters were coming to completion: it

remained to strengthen the last burner and to make several joints. The work is generally usual for the brigade in which there are such experienced specialists as gas cutters and truss builders A. S. Leshchenko, G. F. Alekseyev and S. P. Pasechnik and electric-arch welder A. L. Ashchuk.

"Things are looking good?" smiles the brigade leader, inviting us to look around at the unusual design of the burner. "It looks good."

And the problem of the burner at one time caused much concern among both the power engineers and installers. How was one to deliver gas to the burners of the boilers? There were two methods. The first seemed simpler: install an ordinary gas burner alongside the devices operating on solid and liquid fuel. The second method provided for development of a universal design. This was more complicated but nevertheless the power engineers selected the second method. This burner made it possible to standardize the autoregulation, shielding and interlocking system, which is important upon conversion from one type of fuel to another. Moreover, considerable conservation of funds was provided without a loss of reliability.

Practically all the collectives of the subcontracting organizations appreciably increased the rates of installation by the end of June. The fourth unit of the plant was ready for reception of gas and installation on the sixth unit was 80 percent completed. Main efforts were now directed toward the second unit, which had been left since the middle of June for scheduled major overhaul and renovation.

The laters are also confidently approaching the target. The main section of the gas line--from the zero mark, several kilometers from Gaysin to the Southern Bug in the region of Ladyzhin, has already been laid.

Construction of the gas line and work on conversion of the electric power plant to natural gas are approaching completion. The Ladyzhin GRES will be reborn during the 14th year of its existence.

6521

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